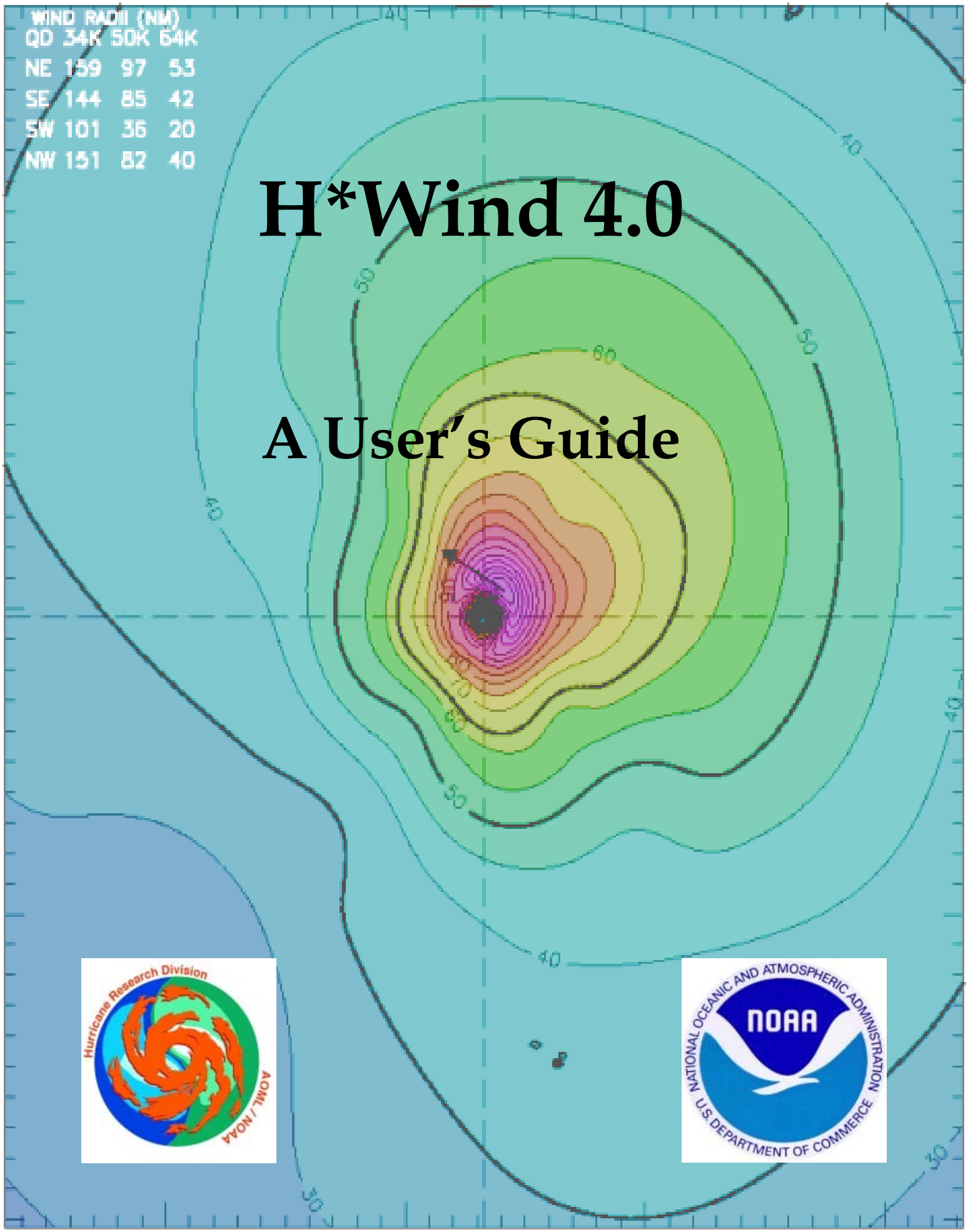

H*Wind 4.0

A User's Guide

Overview

The National Oceanic and Atmospheric Administration's (NOAA) Hurricane Research Division has been producing real time analyses of tropical cyclone surface wind observations on an experimental basis since 1993. HRD's analyses are created by compiling all available observations relative to the storm center upon which the analysis is performed.

The HRD Real-time Hurricane Wind Analysis System (H*Wind) is a distributed system that ingests real-time tropical cyclone observations measured by land-, sea-, space-borne, and air-borne platforms into an object relational database, adjusts them to a common framework, and then graphically displays the data relative to the storm with interactive tools so scientists can quality control, objectively analyze, and visualize the information.

More information can be found on the real-time hurricane wind analysis project website http://storm.aoml.noaa.gov

This guide is intended to provide an overview of the entire application. Each chapter will cover every feature available in the application. A Hurricane Lili (2002) dataset is used as an example to explain many features.

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*On the cover: The background is an H*Wind analysis for Hurricane Lili 0130 UTC 3 October 2002*

TABLE OF CONTENTS

Background

Tropical cyclones are monitored globally by space-, aircraft-, land- and marine-based observing systems. Advances in computing and communications have made it possible to obtain these observations in near real-time. However, scientists involved in operational forecasting and basic and applied research on hurricanes have few tools that enable real-time interaction with, and analysis of, observations gathered in tropical cyclones. In the Atlantic, Eastern Pacific, and Central Pacific Ocean basins, hurricane wind fields are determined subjectively based on the specialist's interpretation of flight-level reconnaissance data, satellite observations, pressure-wind relationships and available surface data. These fields are represented by text portions of the official forecast product as radii (from the storm center) of 34 kt, 50 kt, and hurricane force winds in four compass quadrants relative to north. Until recently, no operational objective method has been available for assimilating and synthesizing disparate observations into a consistent wind field. The HRD Surface Wind Analysis System (H*Wind) is a tool designed to fill this need.

The HRD approach to hurricane wind analysis evolved from a series of peer-reviewed, scientific publications analyzing landfalls of major hurricanes including Frederic of 1979, Alicia of 1983, Hugo of 1989, and Andrew of 1992 (Powell et al., 1991, Powell and Houston, 1996, 1998, Powell et al., 1998). In our paper describing Hurricane Hugo's landfall, we developed the concept of a system for conducting real-time analysis of hurricane wind fields. We were in the process of constructing this system when Hurricane Andrew struck. The system was first used in real-time during Hurricane Emily in 1993 (Burpee et al., 1994). Since 1994, HRD wind analyses have been conducted on an experimental basis to create real time hurricane wind field guidance for forecasters at the National Hurricane Center. During hurricane landfall episodes, HRD scientists work side by side hurricane specialists at NHC analyzing wind observations on a regular 3 or 6 hour schedule consistent with NHC's warning and forecast cycle.

An HRD wind analysis requires the input of all available surface weather observations (e.g., ships, buoys, coastal platforms, surface aviation reports, reconnaissance aircraft data adjusted to the surface, etc.). Observational data are downloaded on a regular schedule and then processed to fit the analysis framework. This includes the data sent by NOAA P3 and G4 research aircraft during the HRD hurricane field program, including the Step Frequency Microwave Radiometer measurements of surface winds, as well as U.S. Air Force Reserves (AFRES) C-130 reconnaissance aircraft, remotely sensed winds from the polar orbiting SSM/I and ERS, the QuikScat platform and TRMM microwave imager satellites, and GOES cloud drift winds derive from tracking low level near-infrared cloud imagery from these geostationary satellites. These data are composited relative to the storm over a 4-6 hour period. All data are quality controlled and processed to conform to a common framework for height (10 m or 33 feet), exposure (marine or open terrain over land), and averaging period (maximum sustained 1 minute wind speed) using accepted methods from micrometeorology and wind engineering (Powell et al., 1996, Powell and Houston, 1996). This framework is consistent with that used by the National Hurricane Center (NHC), and is readily converted to wind load frameworks used in building codes.

Current H*Wind Team and Duties

Mark D. Powell	Principal Investigator
Nick Carrasco	Data flow, software engineer
Neal Dorst	Web Archival
Jason Dunion	Remote sensing, training
Steve Feuer	Science consultant for HRD Spline Analysis
Nirva Morisseau-Leroy	Database developer and administrator
Shirley Murillo	Training, User's guide
Sonia Otero	Software engineering and design
George Soukop	Physicist, analysis product generation
Russell St. Fleur	Database assistance and web design
Eric Uhlhorn	Remote sensing

Past Contributors

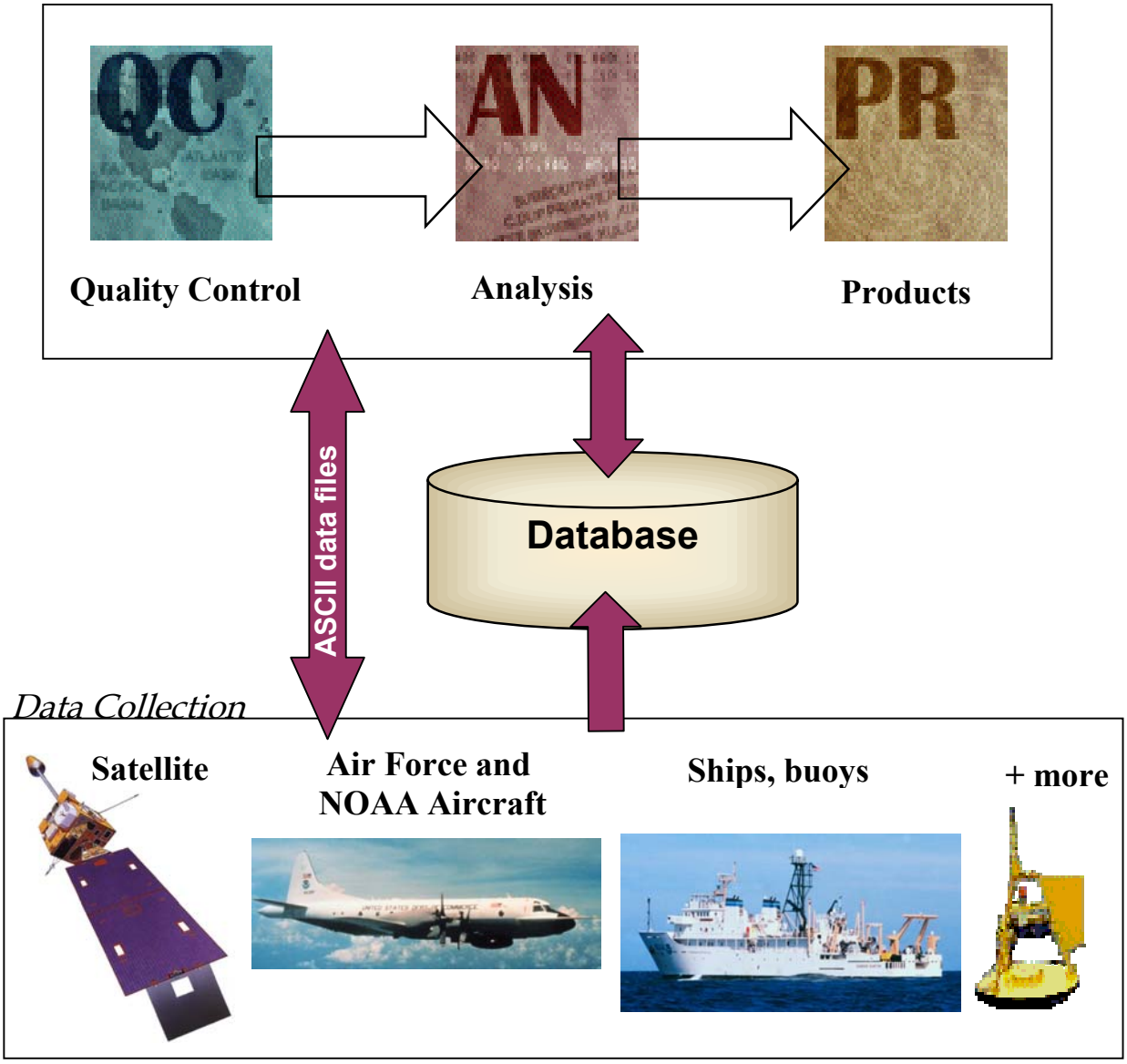
Sam Houston
Luis Amat
Cary Bakker
Gus Pujals
Phillippe DuBosq
Kevin Day

Funding of H*Wind

1998-2000 HPCC (High Performance Computing Communications,
NIBS (National Institute of Building Sciences)
2001-2003 HPCC, ESDIM (Environmental Services Data and Information Management)
2001-2002 JHT (Joint Hurricane Testbed)

H*Wind Architecture

A schematic of H*Wind is shown below. Data are collected from various platforms and ingested into an Oracle database. The data are then examined by users through H*Wind. Users may use H*Wind via ASCII data files bypassing the database.



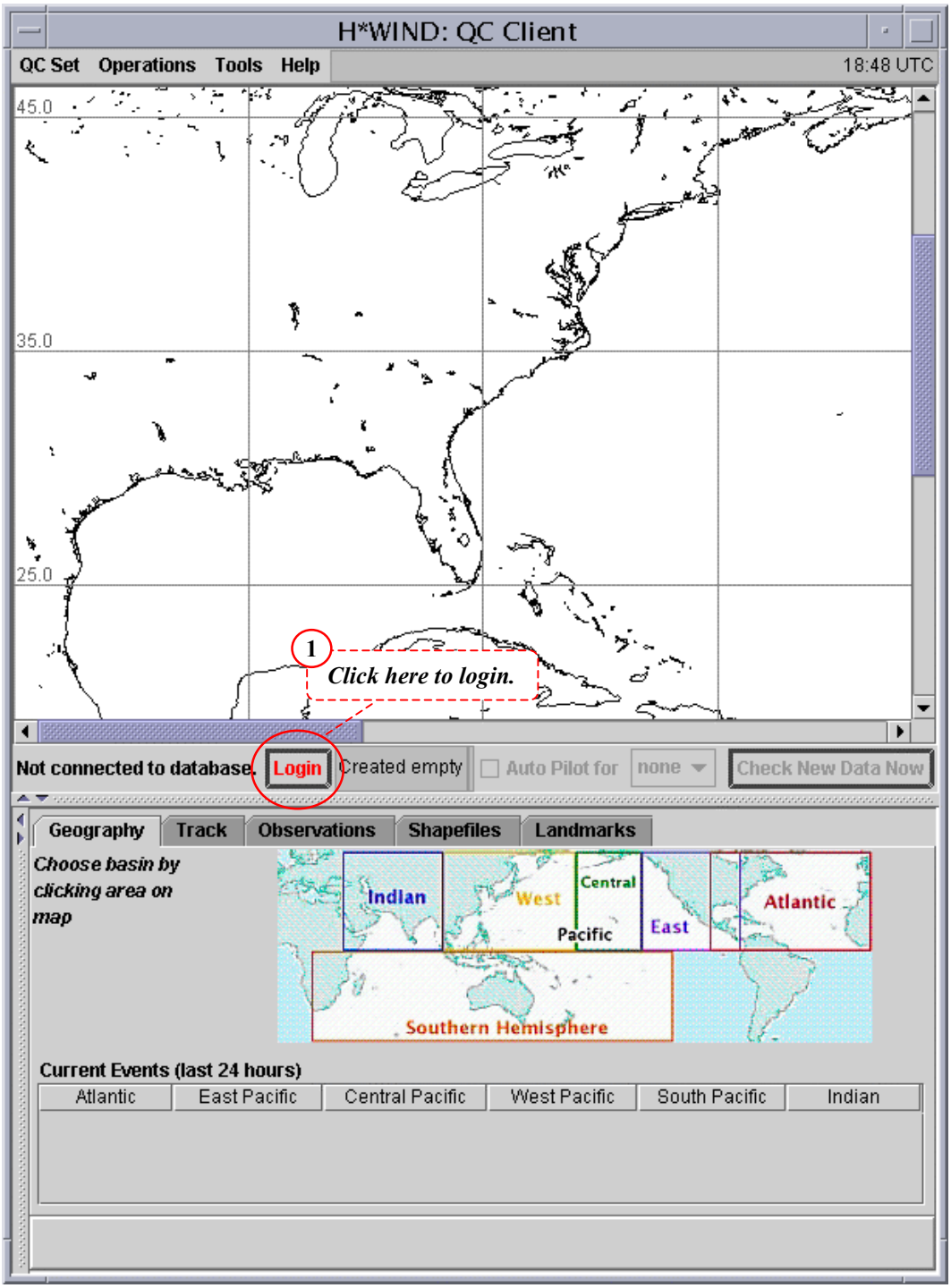
Getting Started

To launch H*Wind, both Java Web Start and Java 2 version 1.4 (at least) are needed. Once the required software is obtained, simply open any web browser to http://cat5.nhc.noaa.gov (shown below) and click Launch H*Wind.

This website also has information on instructions, requirements and where to find the analysis output.

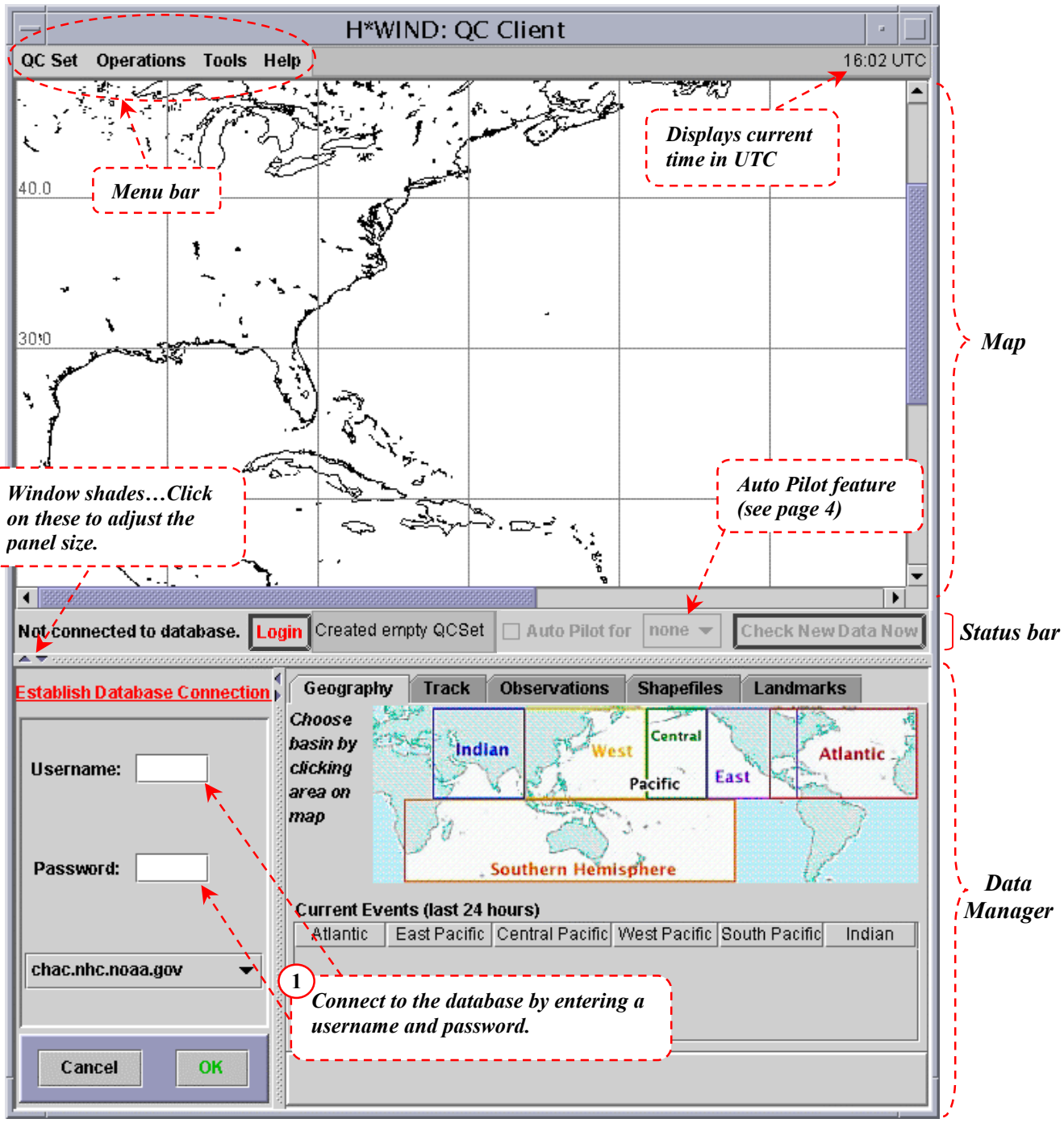
Getting Started (cont'd)

The following window will appear. To login, click on the Login button that is located in the status bar (text box labeled 1).



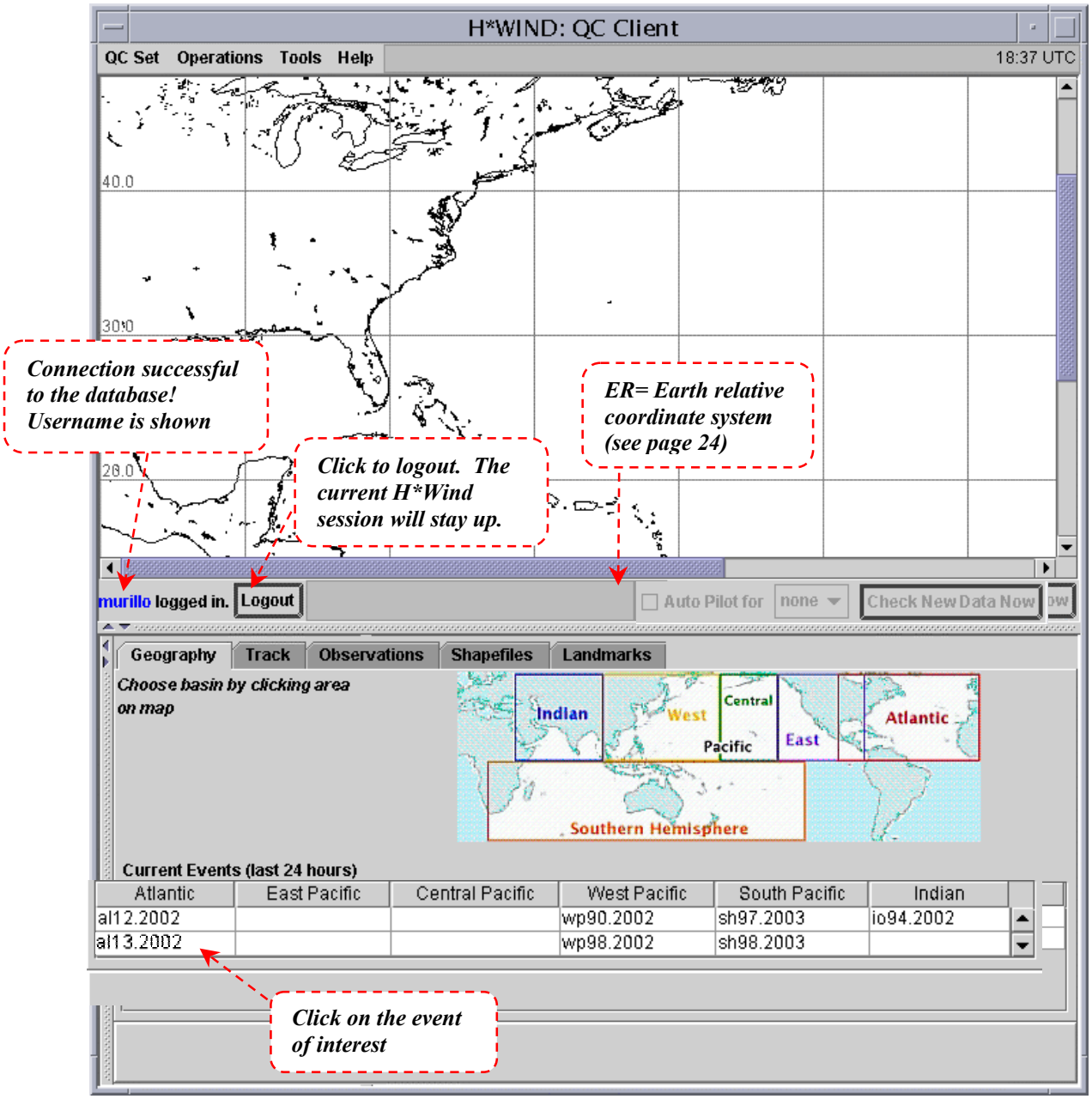
Getting Started (cont'd)

The panel on the lower left will appear prompting the user to login (text box labeled 1). Users will type their username and password to access the database. Several features of the H*Wind application are highlighted below.

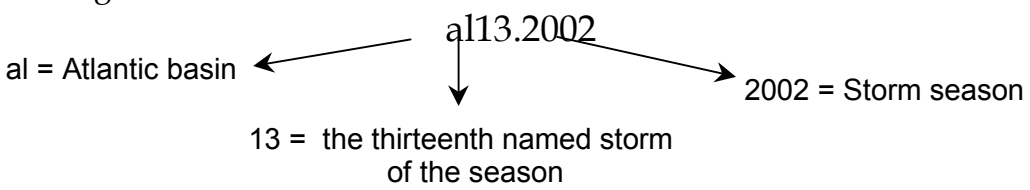


Getting Started (cont'd)

Once connected to the database, any current events will appear under the respective ocean basin. Click on the event of interest.

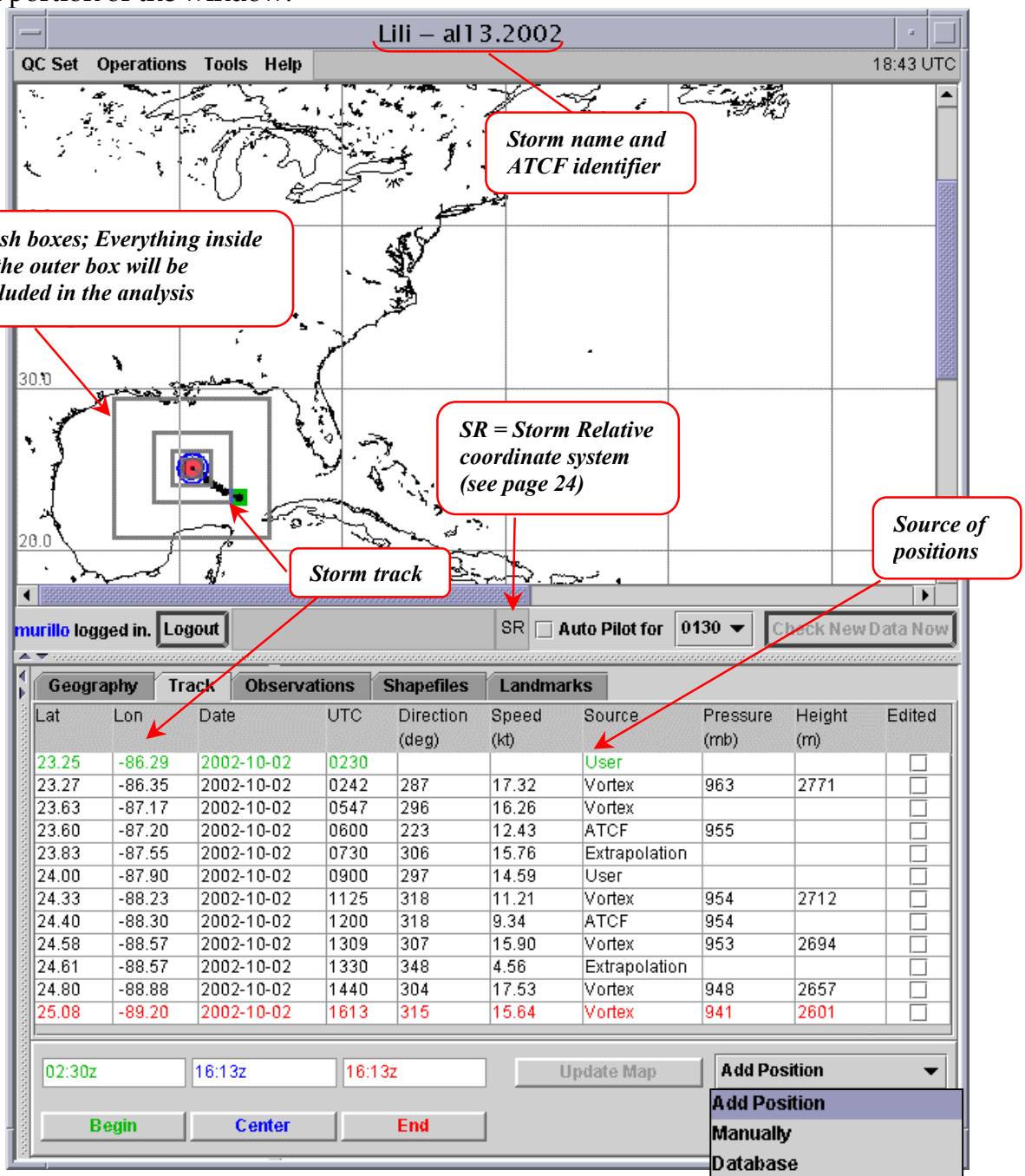


The ATCF names are used to differentiate each tropical system. The event name uses the following naming convention:



The Storm Track

In this manual, Hurricane Lili 2002 (al13.2002) is used as an example. After clicking on the event of interest, the top portion of the window will automatically display the geography for the basin along with the storm track. Additional information for each point is shown in the bottom portion of the window.



A storm position can be added manually, taken from the database, interpolated and/or extrapolated. The next section shows how to add a fix from the database, by interpolation, and by extrapolation.

The Storm Track (cont'd)

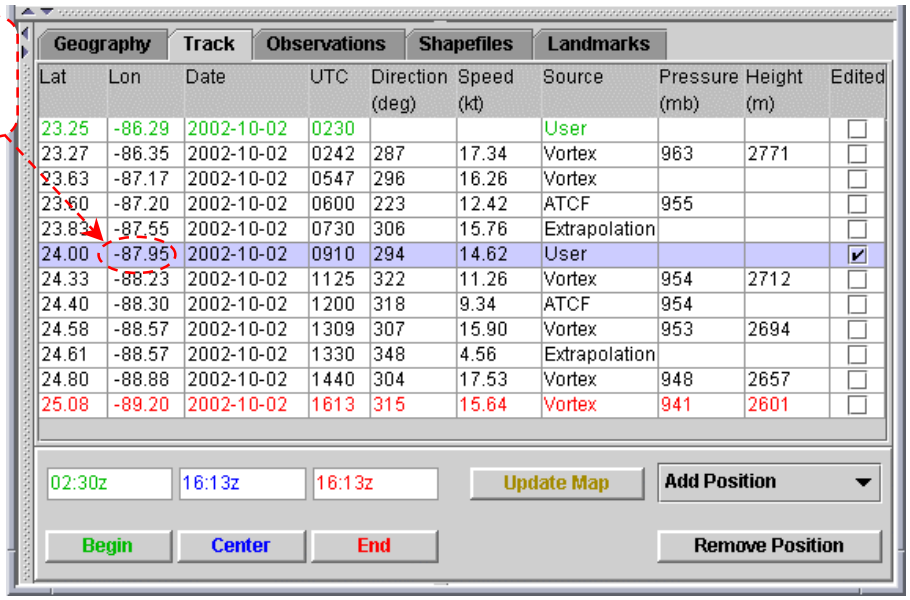
Update Map

This button found on the track panel, will be enabled once the user has made changes to the current track. When activated, the Update map button will retrieve observations based on the begin and end storm positions. If the current track exceeds 12 hours, a warning message will appear requesting the user to limit the time frame.

A closer look at the storm track

Storm track position fields can be edited. Interpolated and extrapolated fixes are NOT editable. To edit, click on the parameter to get a cursor. A check will appear next to the track position that has been edited. The example below shows that that Longitude was changed of the highlighted storm position (see previous page's example to compare). To retrieve the original position, uncheck the box.

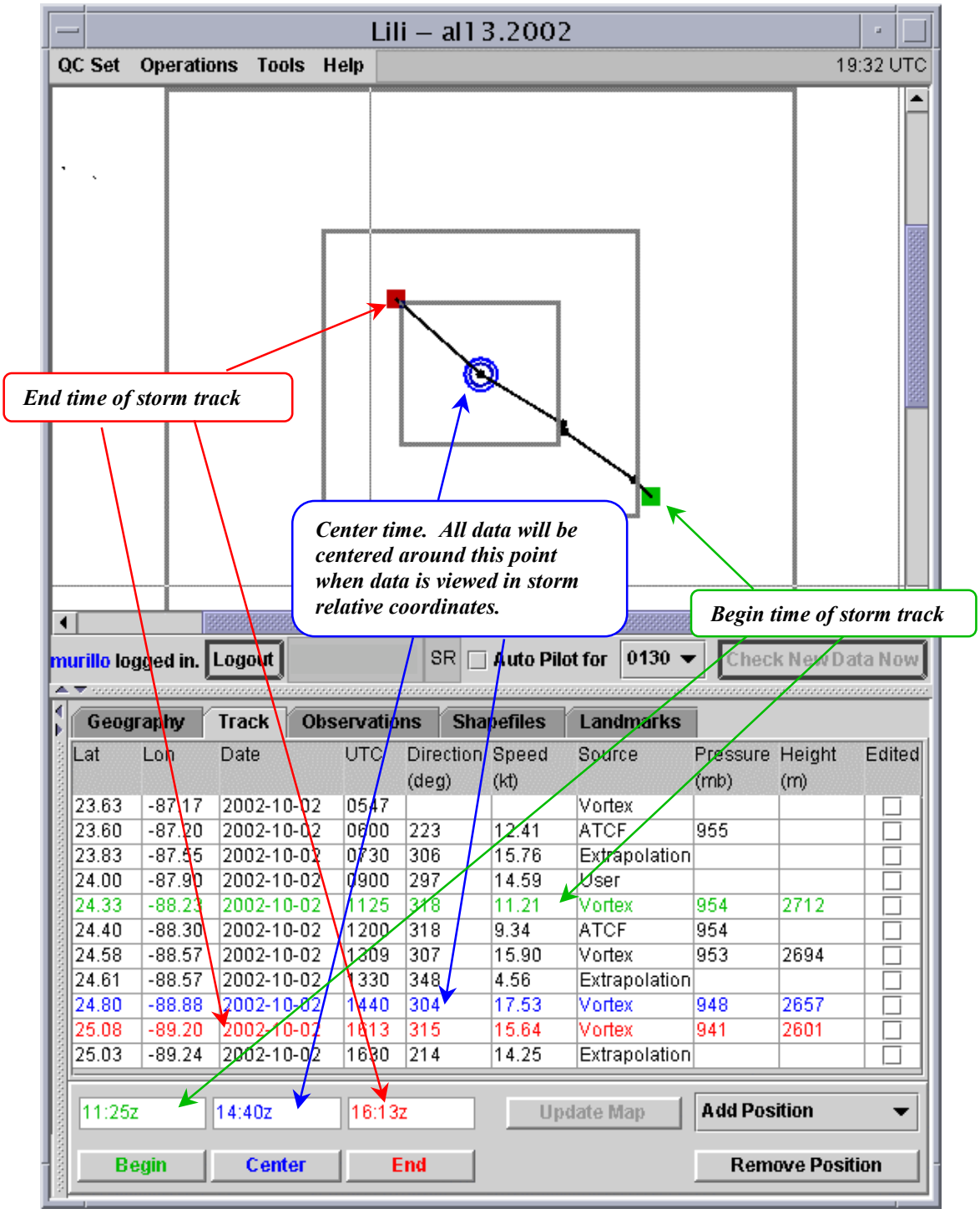
Longitude was changed from -87.90 to -87.95



The Storm Track (cont'd)

A closer look at the storm track (cont'd)

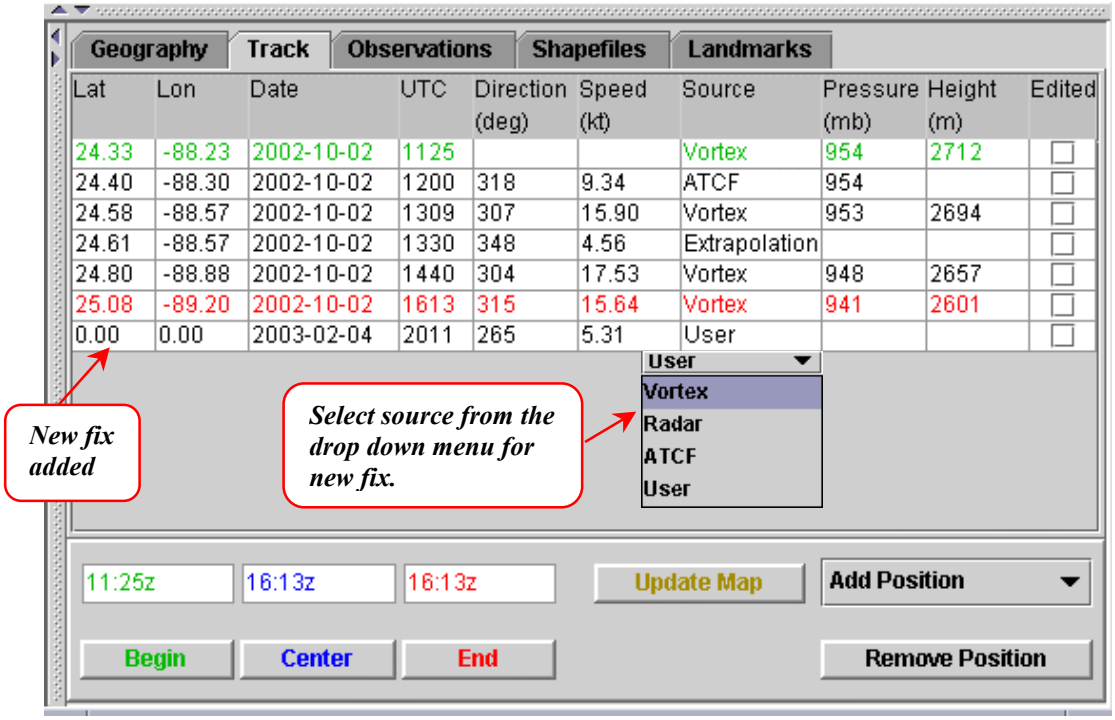
The begin, center and end time locations of the storm track are shown. The points are distinguished by color, both in the map and in the data manager panel.



Adding a position…

Manually

Users can add a position manually. When selecting this option the following will appear on the track panel.



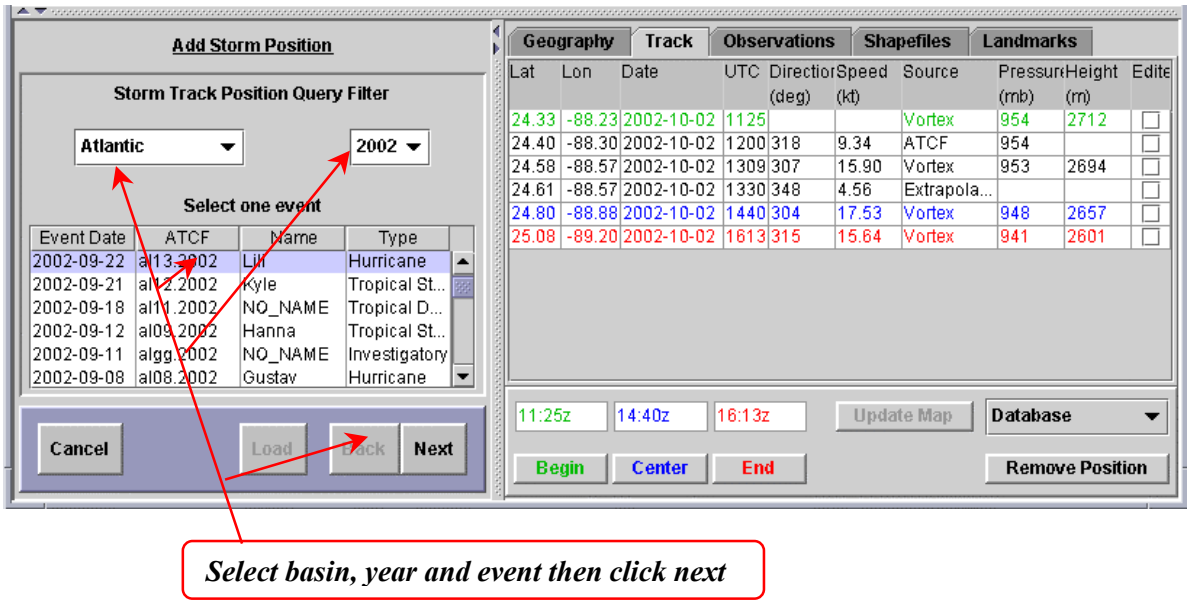
A new storm position will be added with a latitude and longitude of 0.00,0.00. Click on the values to insert the correct information (i.e. the lat/lon, date, and UTC) for the new fix. The storm direction and speed will adjust to reflect the values inserted.

The term 'User' is added under the source column. The source can be changed from 'User' to any of the choices shown in drop down menu that best describes the new storm position. This drop down menu is only available when users add a position manually.

Adding a position… (cont'd)

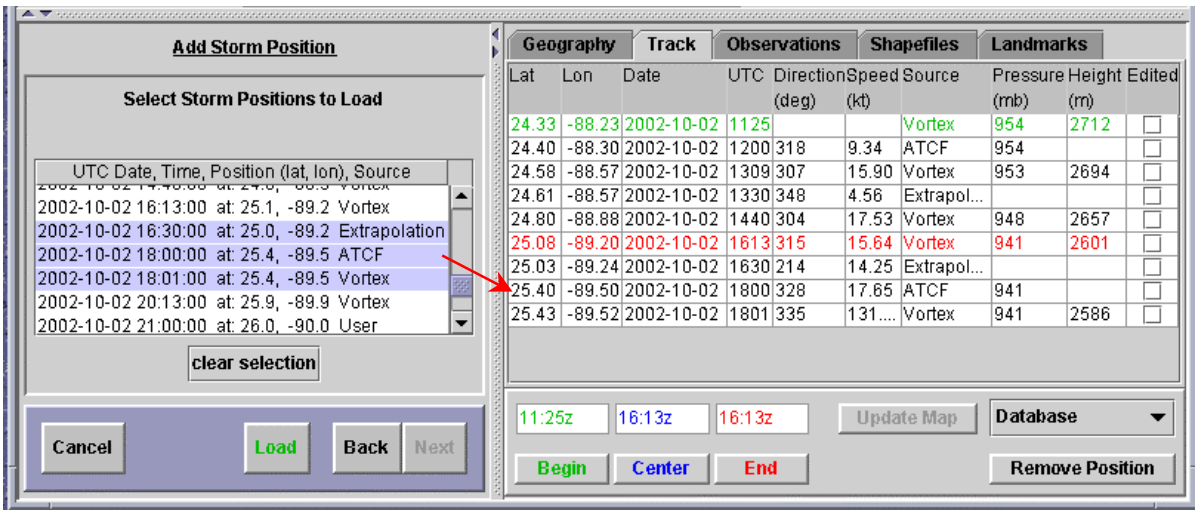
From the database

Select **database** from the drop down menu that appears when clicking the add position button (shown on page 8). The following will appear to the left of the Data Manager window.



Select basin, year and event then click next

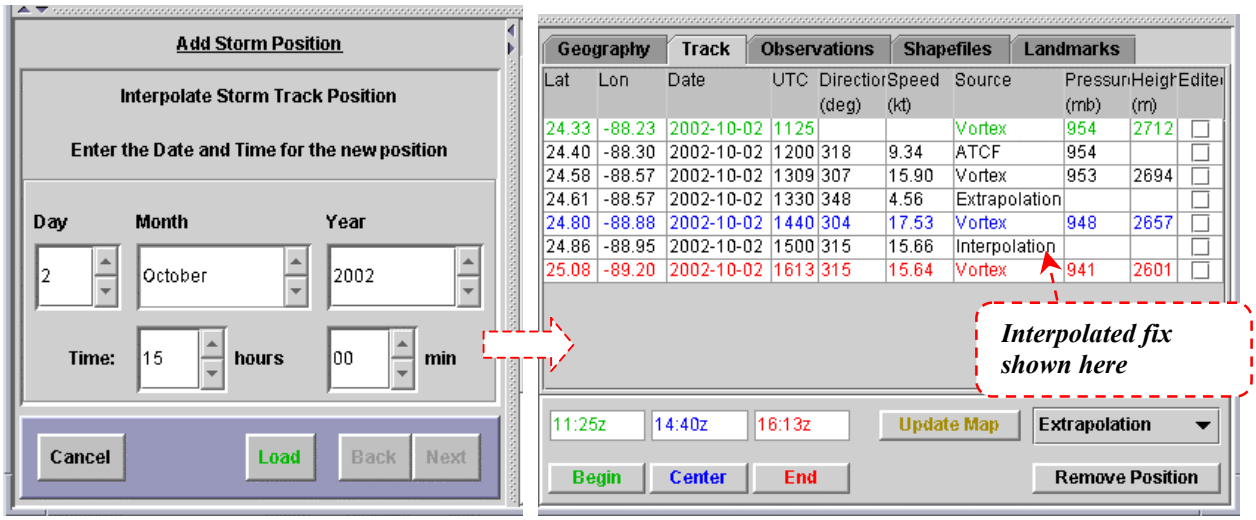
The left panel seen below will display all of the positions for the selected event, as in this example for al13.2002 (Hurricane Lili). Select the desired positions and click Load. Those positions will in be interpolated the right panel seen below, along with the current positions.



Adding a position… (cont'd)

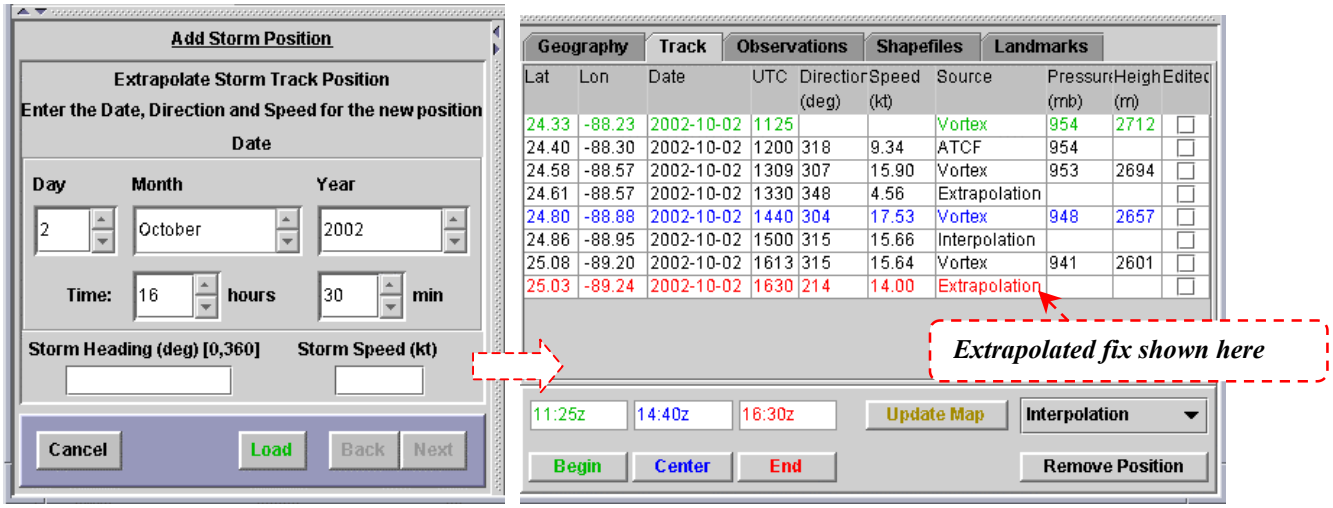
By interpolation

Users can add a position by interpolating between two existing storm positions. Multiple interpolations among interpolated positions can also be performed. When choosing this option the following panel on the left will appear. Select the time for interpolation and click load. The interpolated position will appear in the right panel along with the current track.



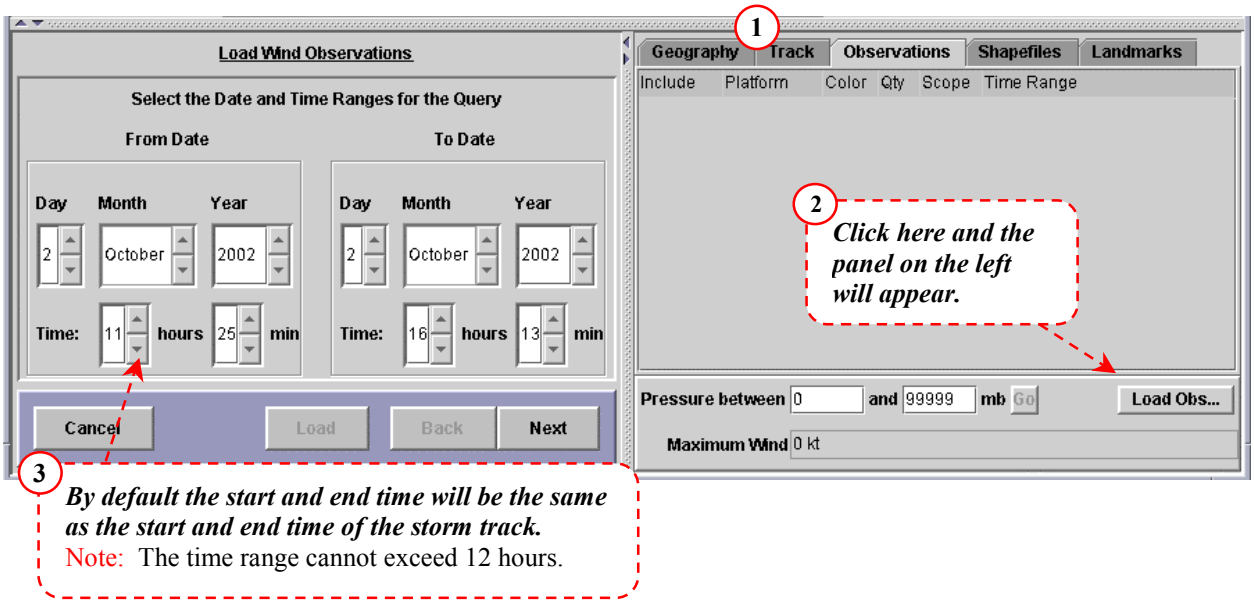
By extrapolation

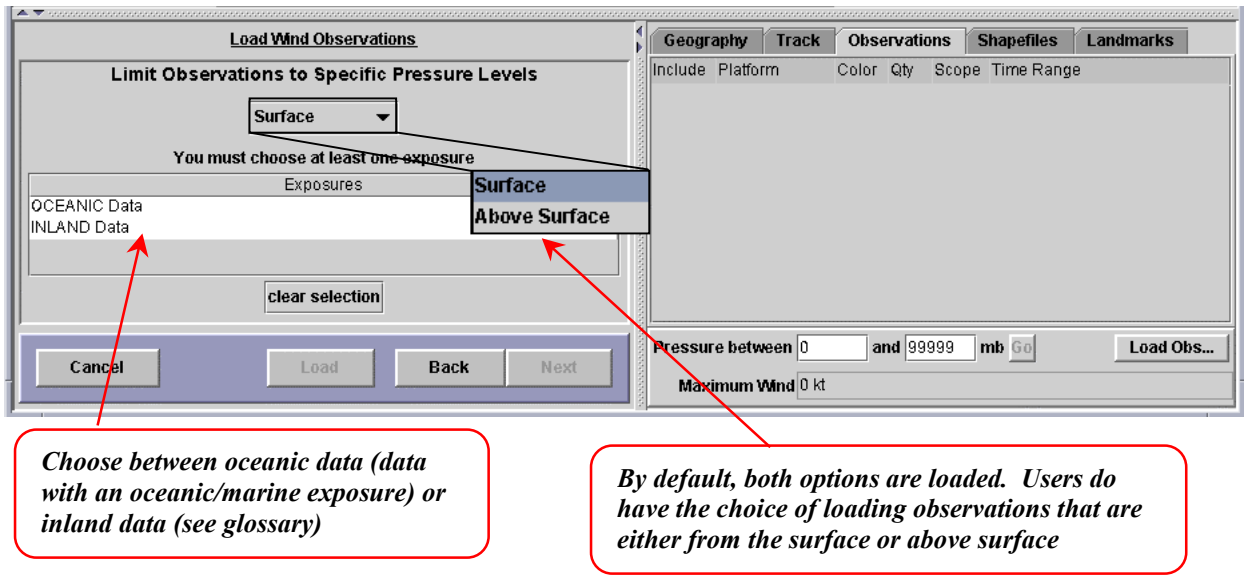
A user can add a position by extrapolating forward or backward in time therefore, an extrapolation will be based either on the end or begin position, respectively. When choosing this option, the following lower left panel will appear. Select the time as well the storm motion (heading and speed). The extrapolated position will then appear in the right panel along with the current track and marked as the new end or begin position of the track.



Observations

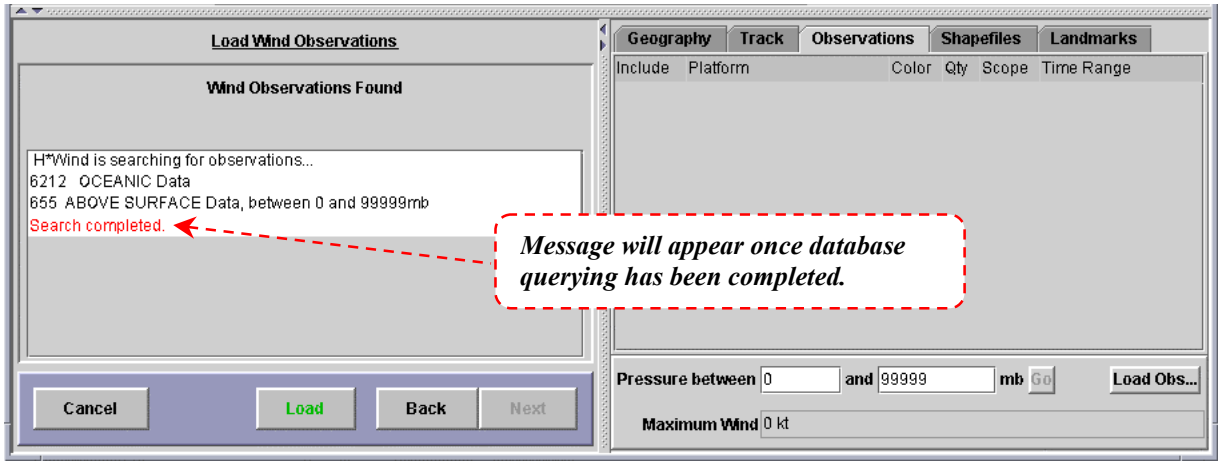
Once the track is set, it's time to bring in the observations. There are four ways to obtain observations. They can be loaded from the database, imported from a file system (page 50), retrieved through the Auto Pilot button (page 17), or through the Update Map button (page 9). This section describes loading observations from the database through a customized set of windows. Click on the tab in the top right portion of the panel that says **Observations**. Click on the bottom right button that says **Load Obs.** The following series of panels will appear on the left.



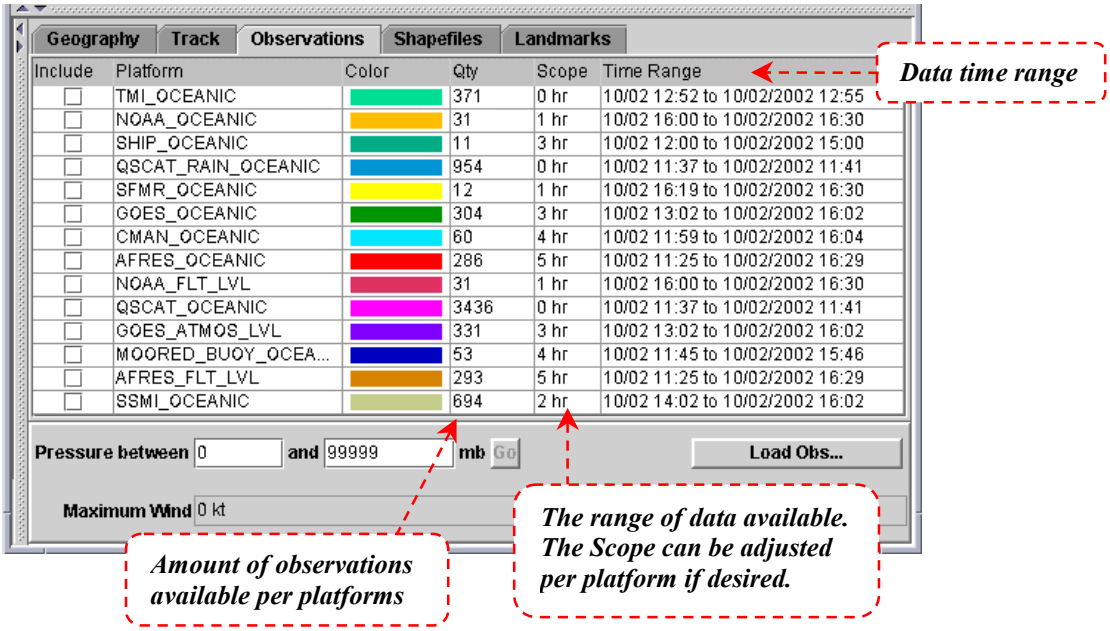


Observations (cont'd)

A request is made to the database to retrieve all the data. This process will take longer if your date/time range window is large. Below is the final panel of the series that will appear on the bottom left of the H*Wind display. This panel informs users on how many observations were found. Click Load once the database has finished querying.

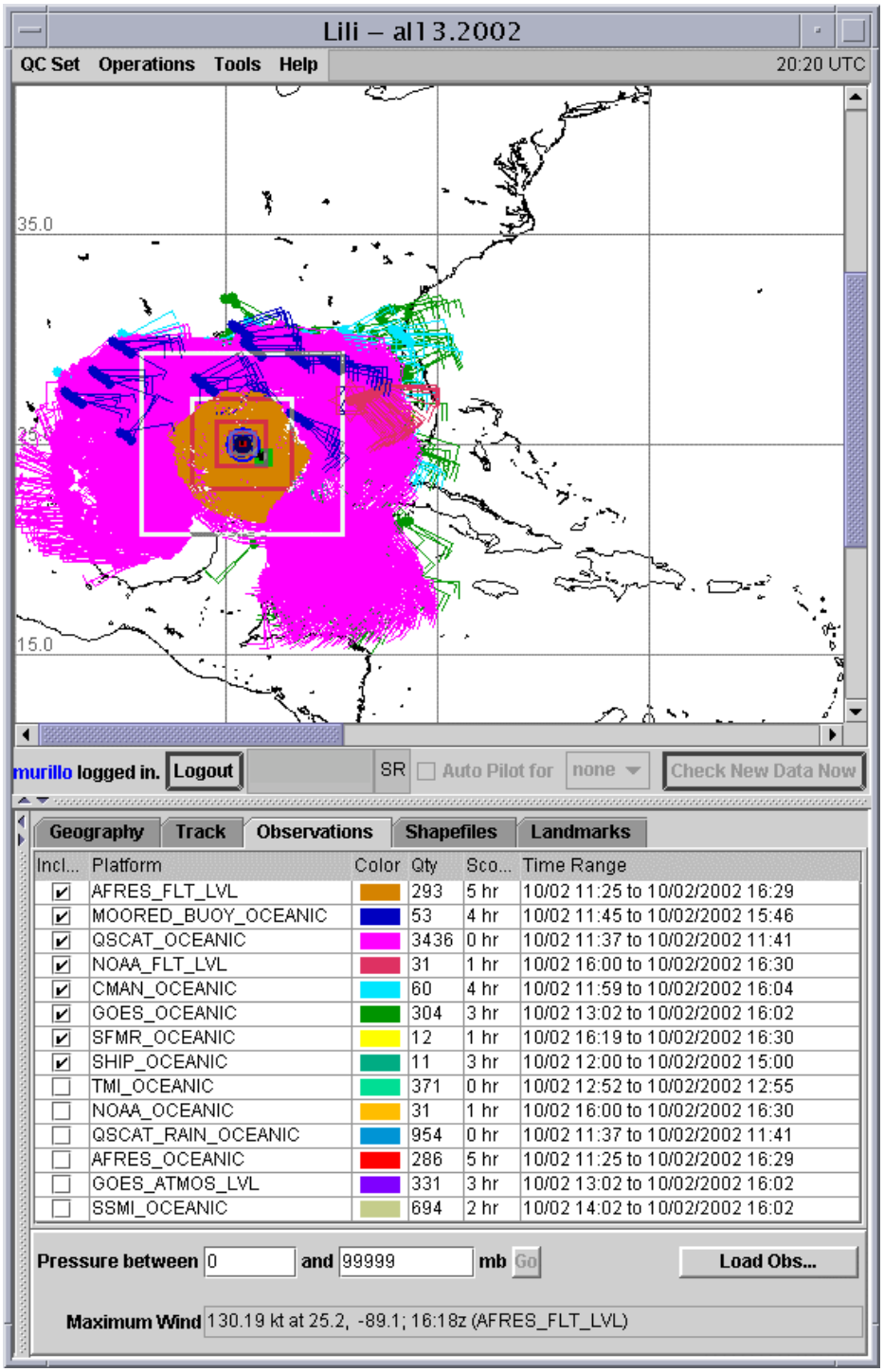


Now you are ready to view and quality control the data. By default, certain platforms will automatically appear (see next page). Below is the panel showing a list of data platforms that were found. Click on the box to the left of the platform name, under the **Include** column to view.



Observations (cont'd)

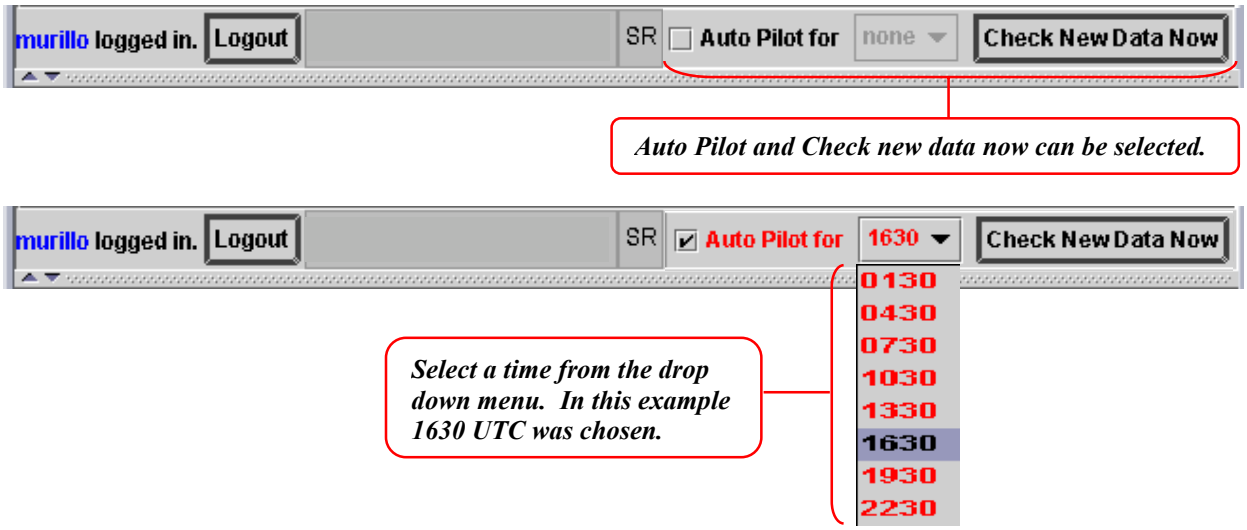
Below is an example of the default platforms that will automatically appear. The platforms are checked and shown on the map portion of the H*Wind window.



Auto Pilot

This button, located on the status bar, will run some of the H*Wind commands with minimal user input. It is intended for operational use. The **Auto Pilot** button can be selected once these conditions are met: 1) a storm track is loaded and 2) the difference between the end time of the storm track and the current time is less than or equal to six hours. To activate this feature, click on the box or the drop down menu. The Auto Pilot button will turn red when activated. The drop down menu has several UTC times to choose from (see below). Select a time and the current storm track will extrapolate to that time using the same storm motion as the end time currently chosen. The **Auto Pilot** option will also retrieve data and storm track positions every ten minutes up to the selected time. If an earlier time than the end track time is chosen, the extrapolation will default to the next calendar day. If a new storm position comes in before the extrapolated time, the current extrapolation will not change. Users will need to remove the extrapolated position and extrapolate again using the new storm position. To deactivate, uncheck the Auto Pilot box.

*Status bar (found in the middle of the H*Wind window)*

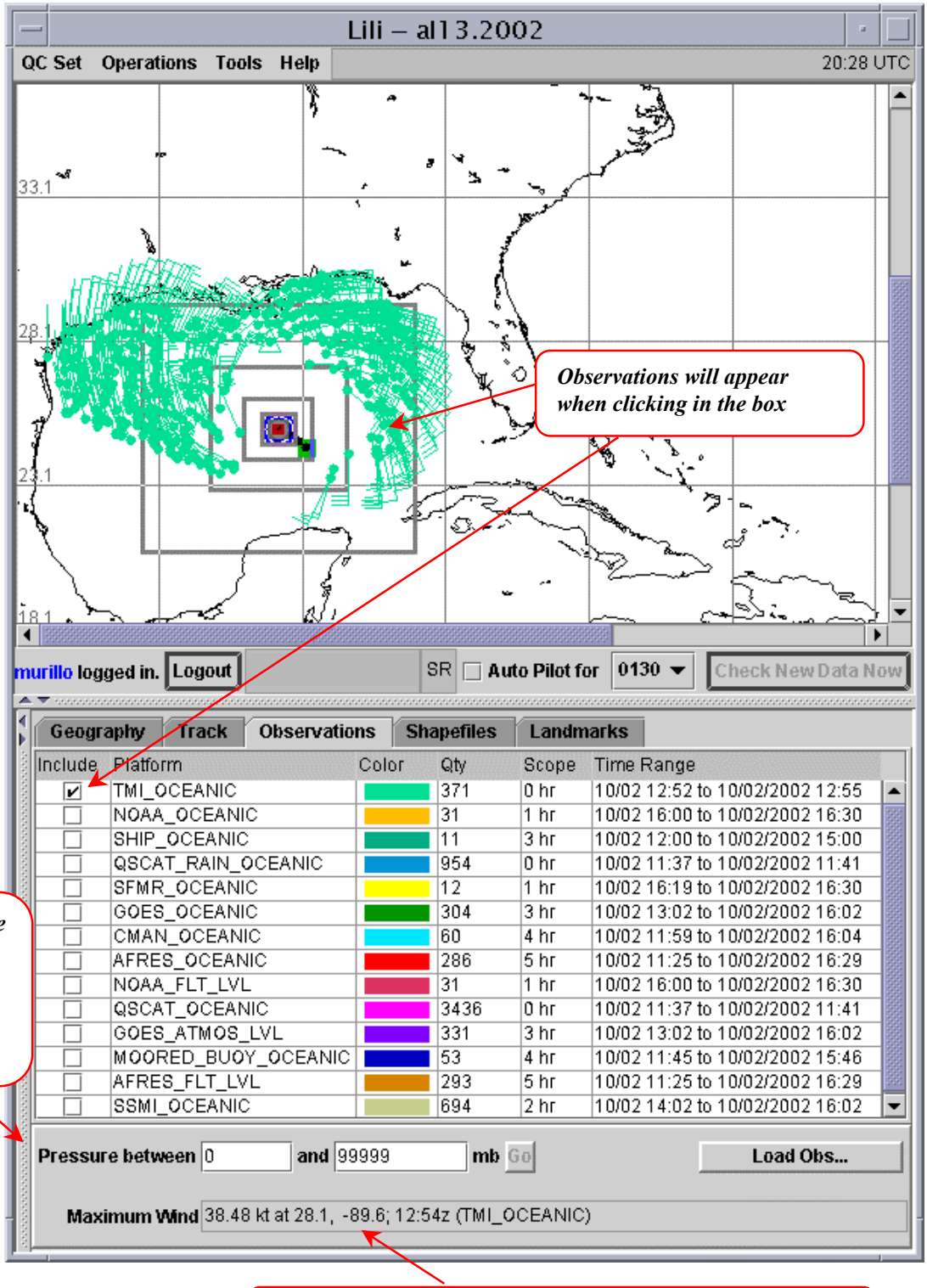


Check New Data Now

This button will check for new observations and storm positions from the database every time it is activated. This feature is used during real-time operations. It will load any new positions passed the starting time of the current track time. It will query observations for the current track range. The **check new data now** button can be selected once a track is loaded. If the difference between the end track time and the current UTC time exceeds six hours, the **check new data now** button will not be enabled. These rules also apply to the **Auto Pilot** button. If the current time is past the end track time, no new observations will appear until end track time has been changed.

Quality Control Tools

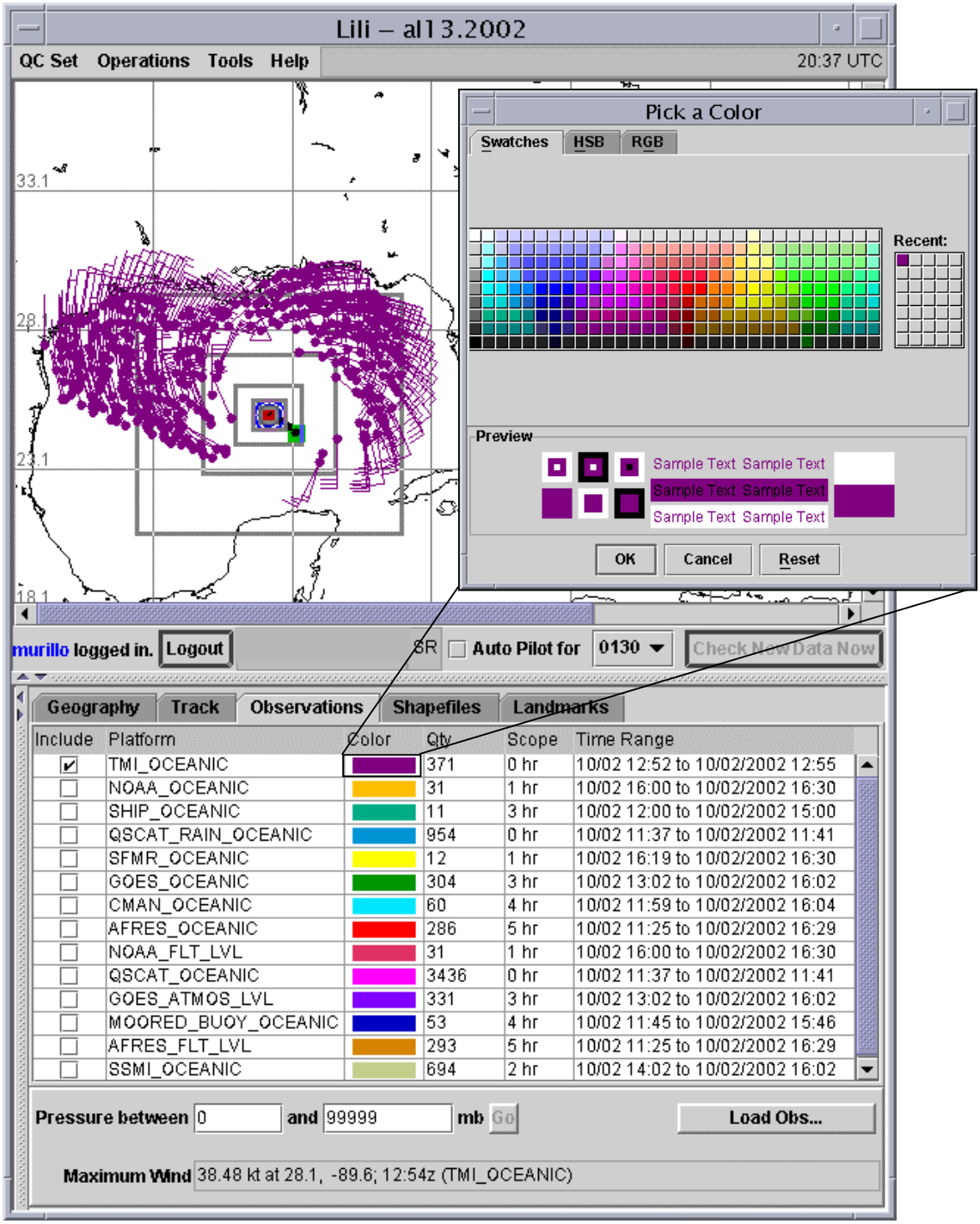
Display Characteristics



Quality Control Tools (cont'd)

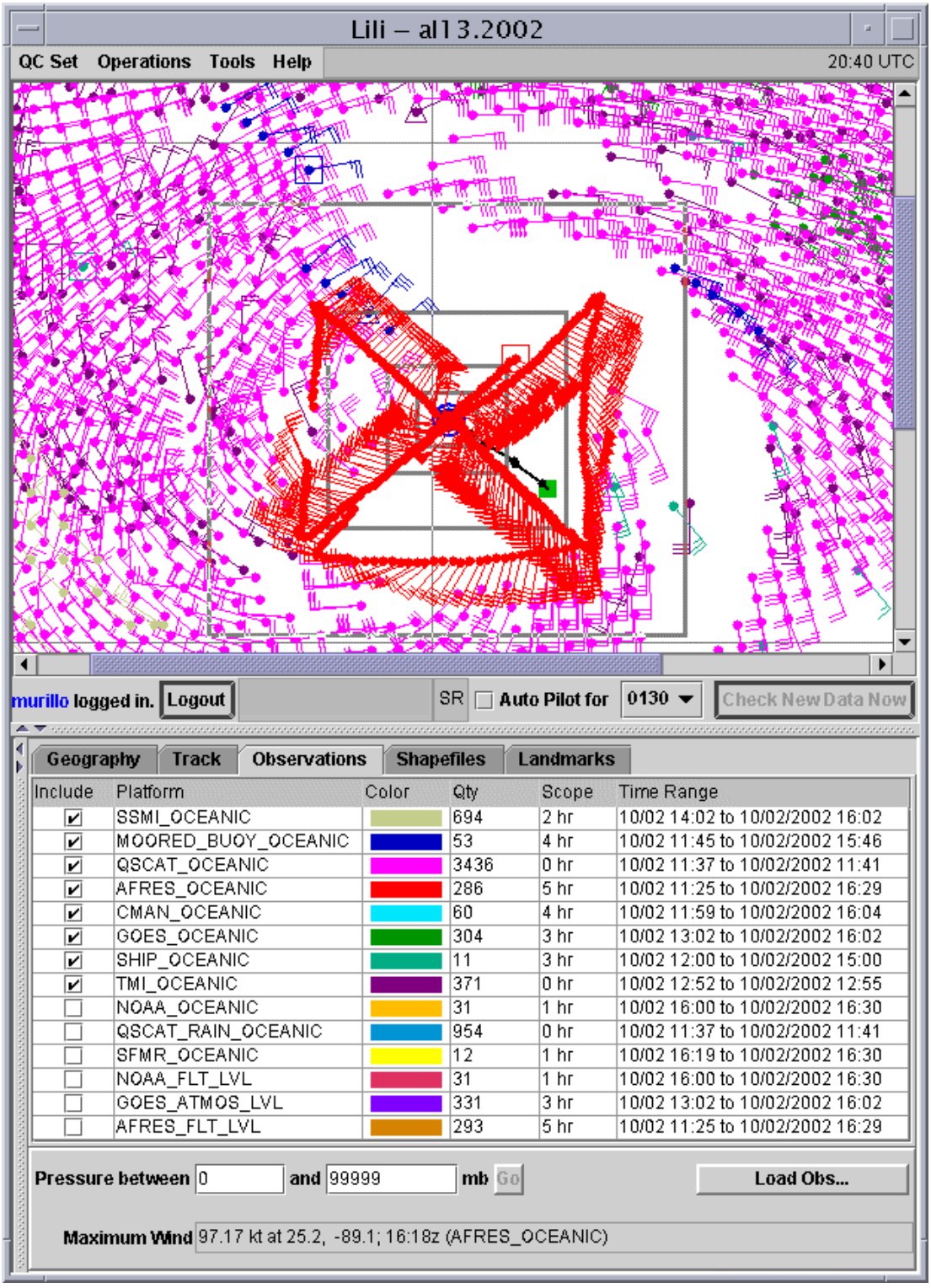
Changing color of platform

To change the color of any platform simply click on the color and a color palette window will appear. Select the desired color.



Quality Control Tools (cont'd)

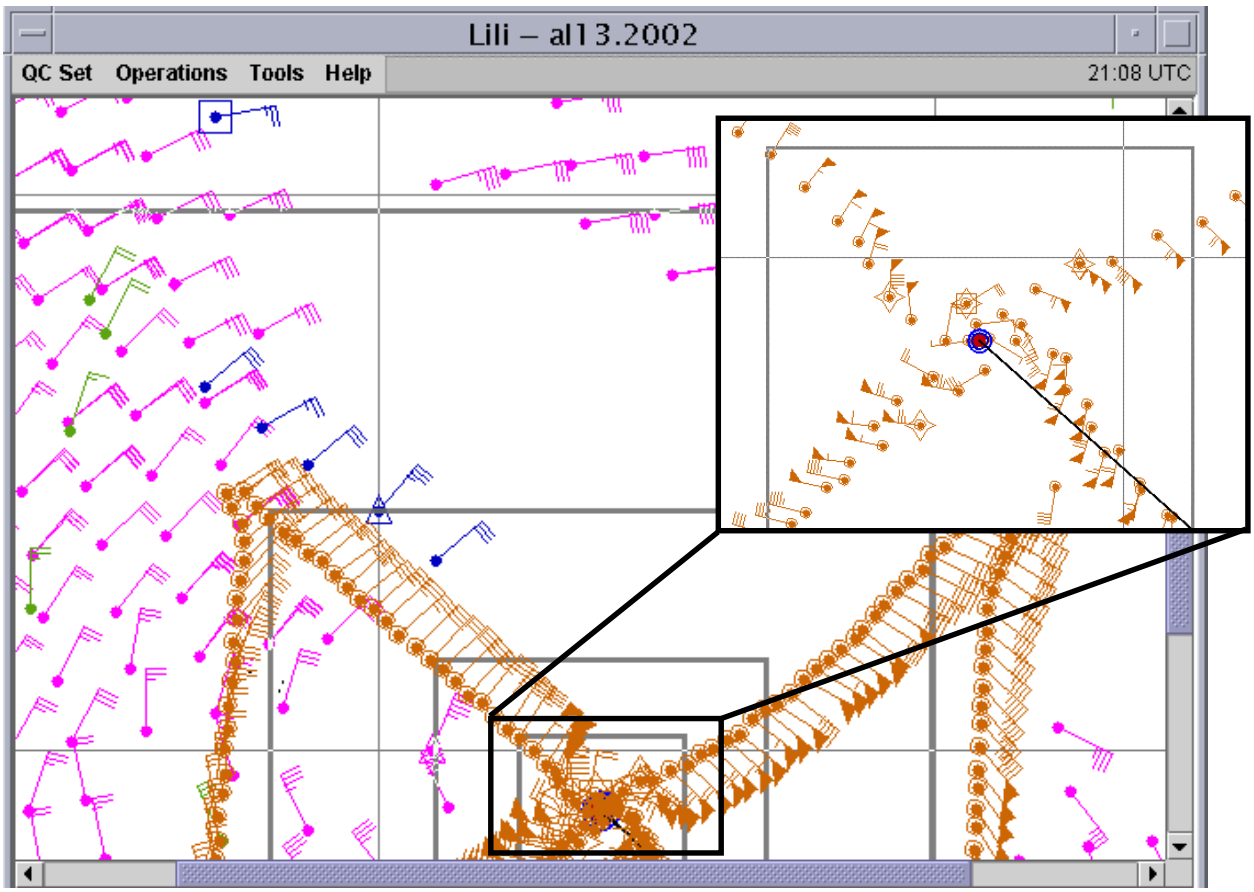
Below is an example showing several observations that have been included in the map.



Quality Control Tools (cont'd)

Symbols and what they mean

When zooming in (see page 24), users will notice that certain wind barbs have special symbols. A combination of these symbols can also be found for a single observation. Below is a brief explanation.



The observation with the latest arrival time per platform.

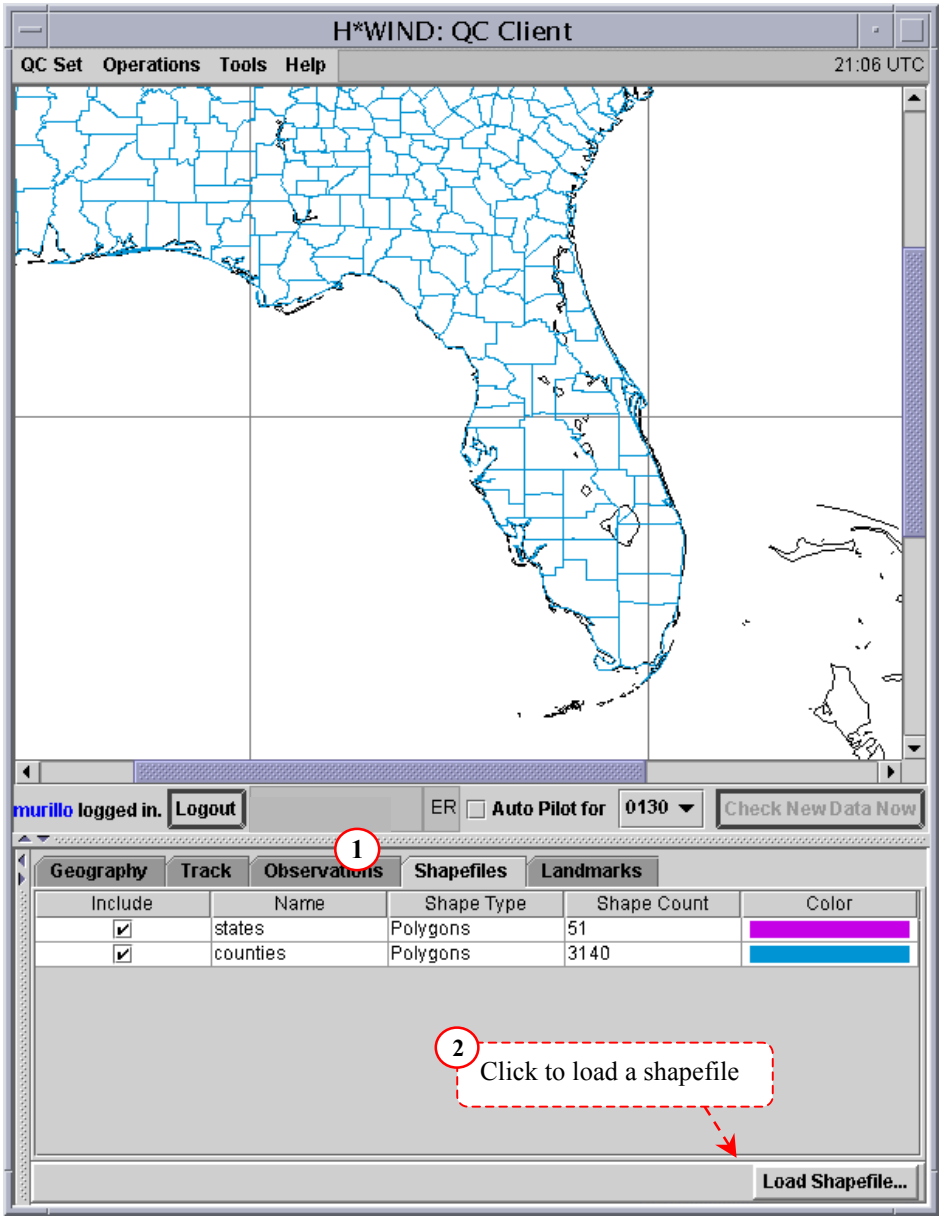
The observation with the highest wind speed reported per platform

An observation that has been edited

The observation with the maximum wind speed per quadrant based on storm motion (e.g. front right, left rear). Only used for NOAA or AFRES flight level data.

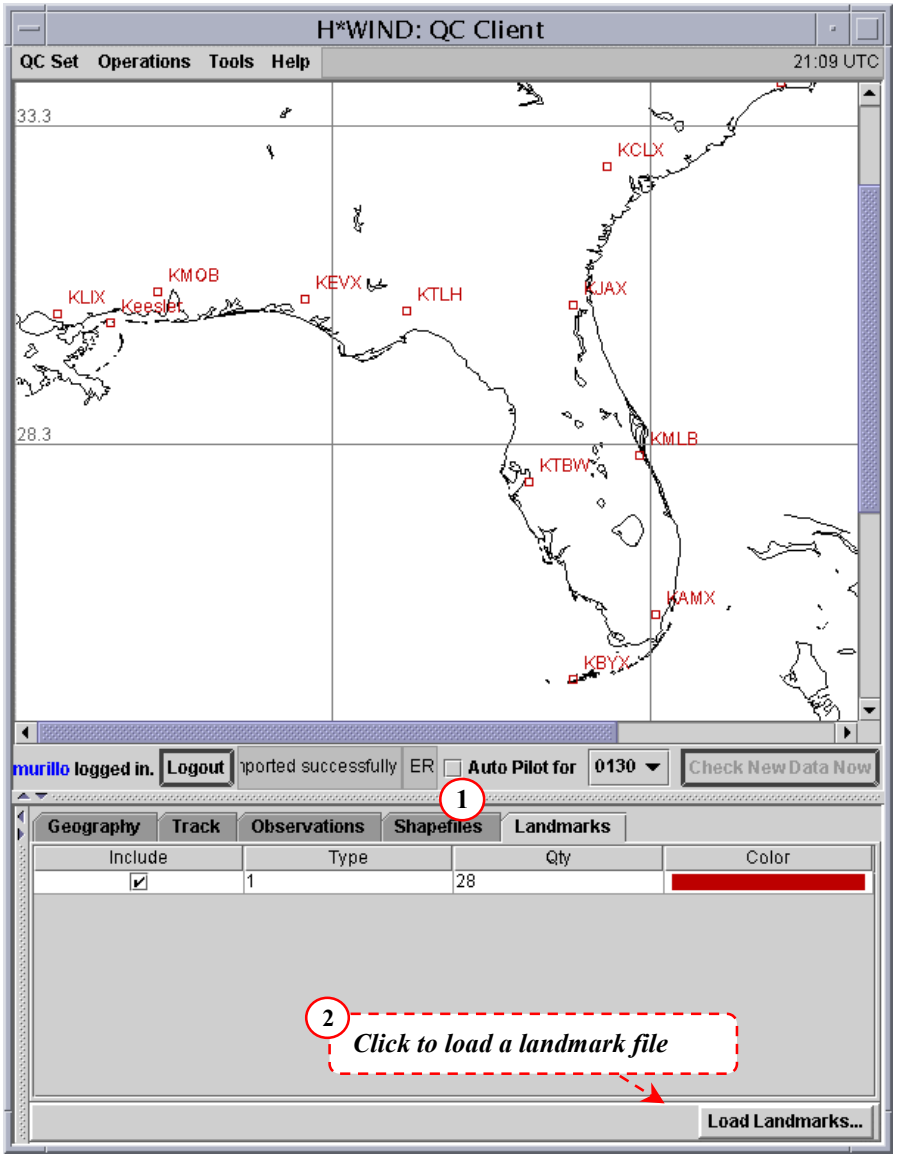
Shapefiles

Shapefiles are binary data files that contain information of certain geographical aspects. These files are not part of the H*Wind application but can be found with any GIS application or the Internet. To load a shapefile into H*Wind, click the tab that says **Shapefiles**. Next, click on the button on the bottom right of the window that says **Load Shapefile**. Shapefiles have an *.shp* extension. H*Wind will look for files in the users home directory with this extension. Two shapefiles (states and counties) that have been loaded into H*Wind are shown below.



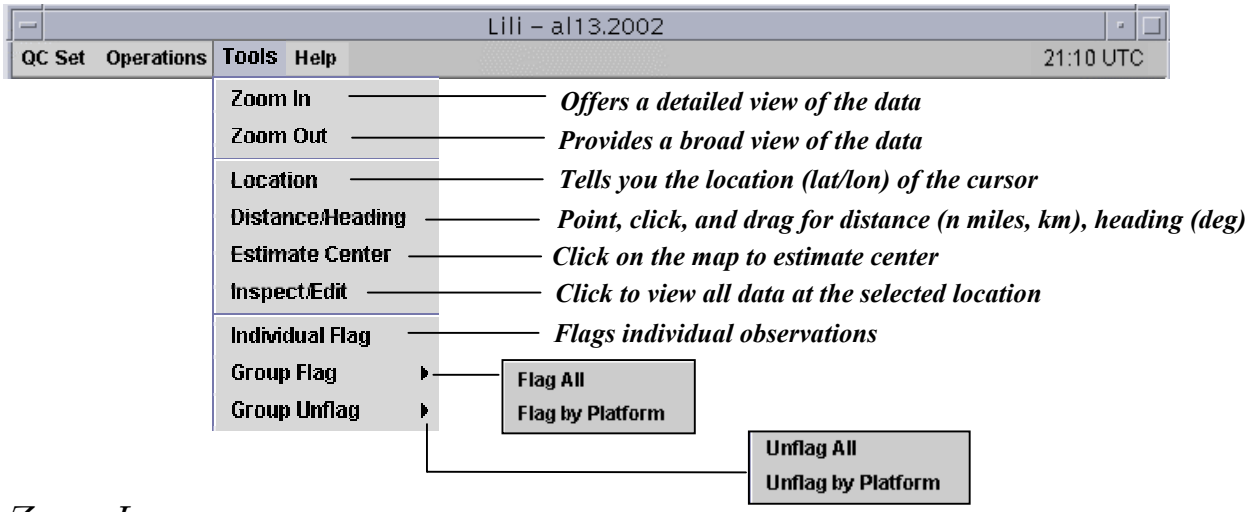
Landmarks

Landmark ASCII files contain information on various geographical landmarks. Just like shapefiles, these files are not part of the H*Wind application. Landmark files can be found in any GIS application or on the Internet. An example of a landmark file is shown below. To load a landmark file, click on the tab that says **Landmark**. Next, click on the bottom right button that says **Load Landmarks**. H*Wind will look for files in your home directory. Landmark files have a *.lmk* extension. The file shown below is a landmark file that contains the station ID and location of WSR-88Ds (radar sites) along the coast.



Tools Menu

These features will help users in the quality control process. The tools menu is found at the top of the main H*Wind window. It can also be brought up by clicking on the right mouse button on the map area of the display. Tips on how to use each tool can be found in the status bar located in the middle of the H*Wind window.



Zoom In

The **zoom in** tool provides a closer look at the observations. Click on the left-mouse button to form a box on the area of interest. The smallest domain size allowed is 0.1 x 0.1 degrees.

Zoom Out

This tool has similar functionalities as the **zoom in** tool. Left-click once on the mouse and it will step back to the previous zoom area. The cursor will change appearance when using this tool.

Location

The **location** tool will give you the location in degrees latitude and longitude of the geographic position the cursor represents. The cursor will appear as a cross hair when using this tool.

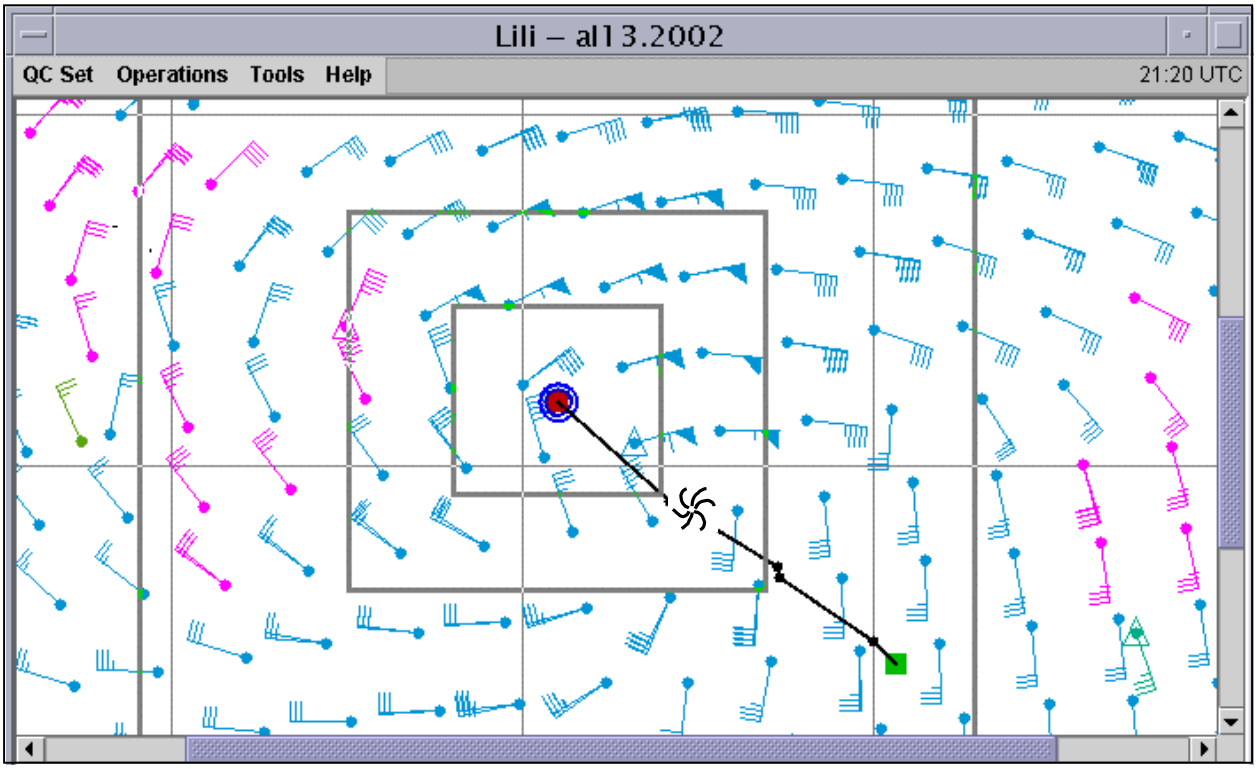
Distance/Heading

This tool provides the distance and heading from one point to another. Distance is given in nautical miles and kilometers. The heading is given in degrees. The cursor will be a cross hair when choosing this tool.

Tools menu (cont'd)

Estimate Center

This tool aids the user to quickly estimate a center location versus having to enter that location manually on the track panel. It can be used when a current storm center is not available or the user wants to estimate a center based on observations, such as QuikScat data. When this feature is chosen, the cursor will change appearance to look like a cyclone (see below). Place the cursor on the map where the storm center estimate is desired and click. A window will appear letting you know what date and time will be designated to the estimated center position. The date and time is taken from the closest observation. Click **ok** and the estimated center will now appear in the track panel. Click **Update map** to view the new center on the map. **The plot mode was set to earth relative (see page 31) to see the actual location of the QuikScat data.**

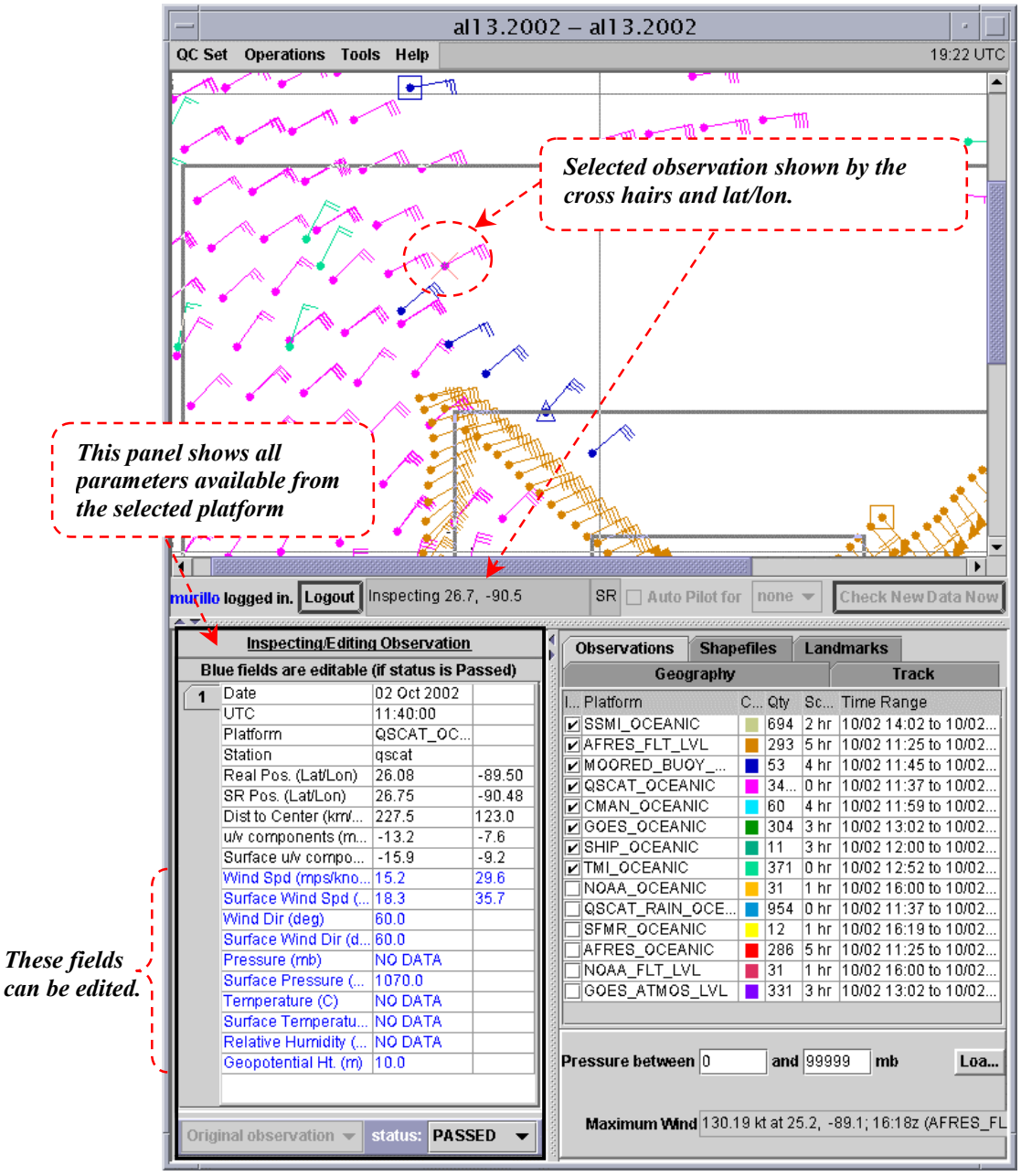


Window will appear showing the date and time that will be used for the new center.

Tools menu (cont'd)

Inspect/Edit tool

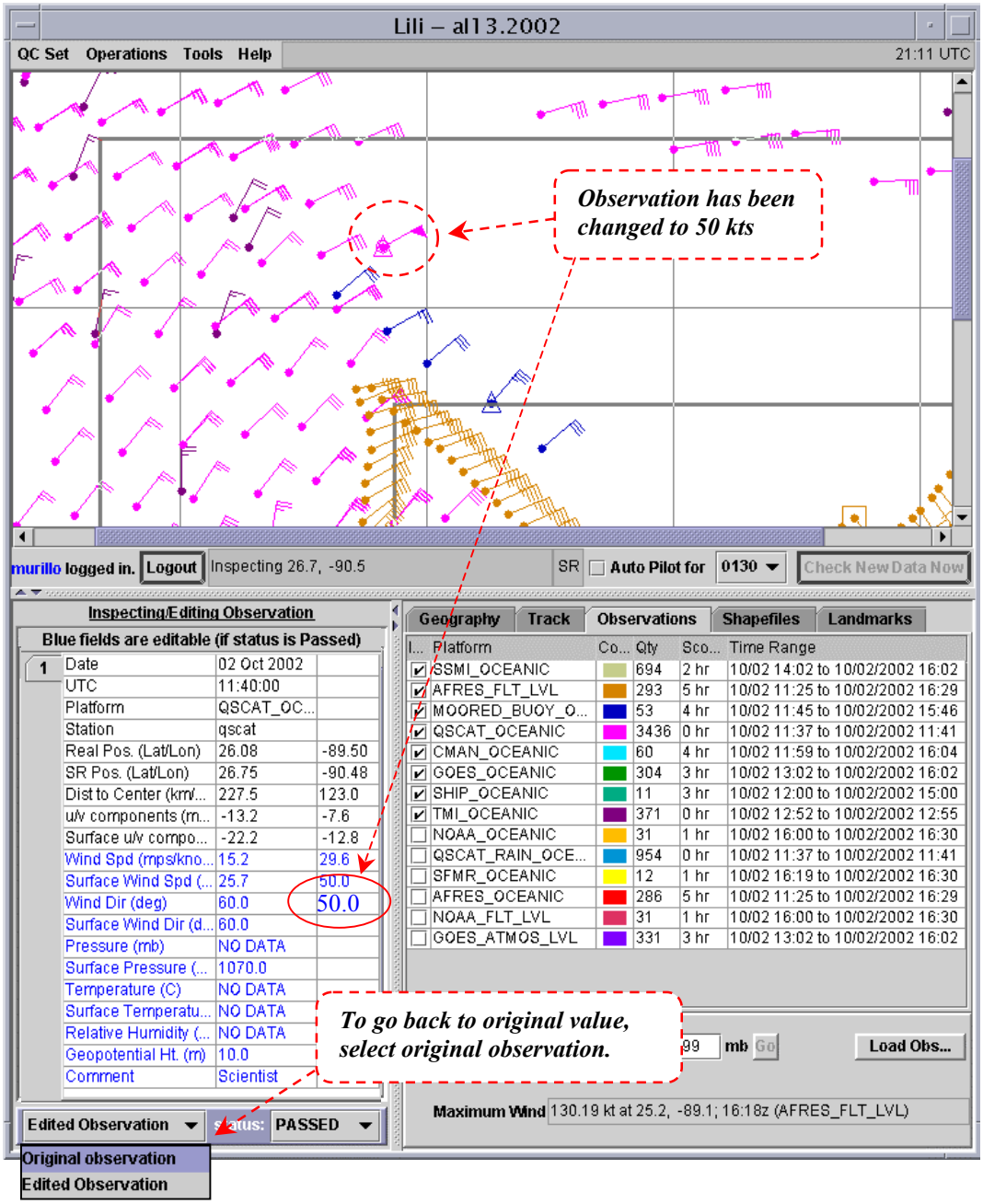
The inspect/edit tool offers the capability of inspecting individual observations and editing them. Click on the desired observation to view all associated meteorological parameters. Certain fields can be edited if needed. Below is an example of the tool.



Tools menu (cont'd)

Inspect/Edit tool (cont'd)

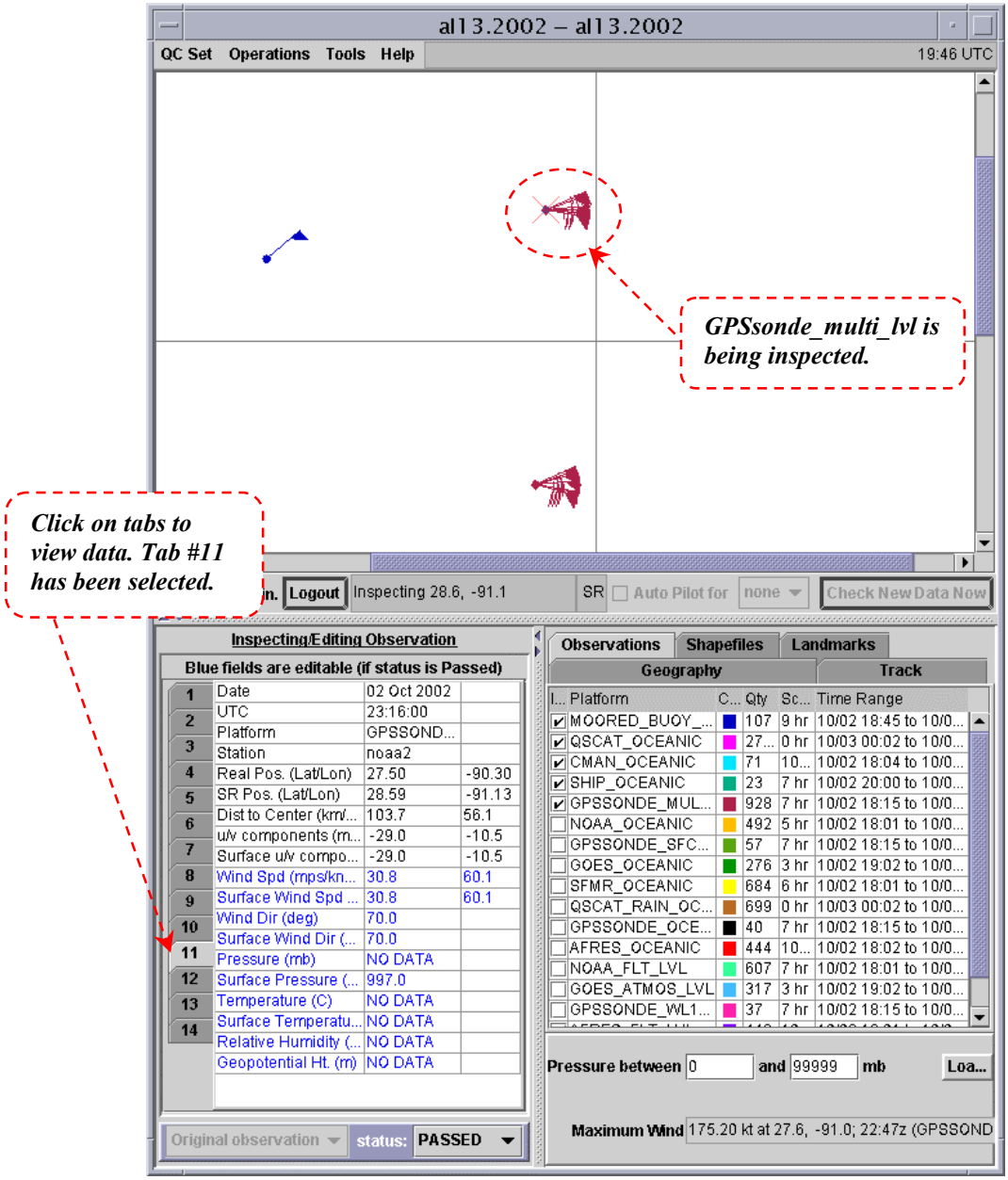
In this example, the surface wind speed category has been changed to 50 kts (25.7 ms^{-1}). The inspector panel on the lower left now shows that it is an edited observation. The wind barb is redrawn to reflect the new wind speed and is now encircled to indicate that it is an edited observation. The new value is now the highest wind speed denoted by the triangle for that platform (Qscat_Oceanic). To obtain the original observation click on the drop down menu at the bottom of the inspector panel and select **original observation**.



Tools menu (cont'd)

Inspect/Edit tool (cont'd)

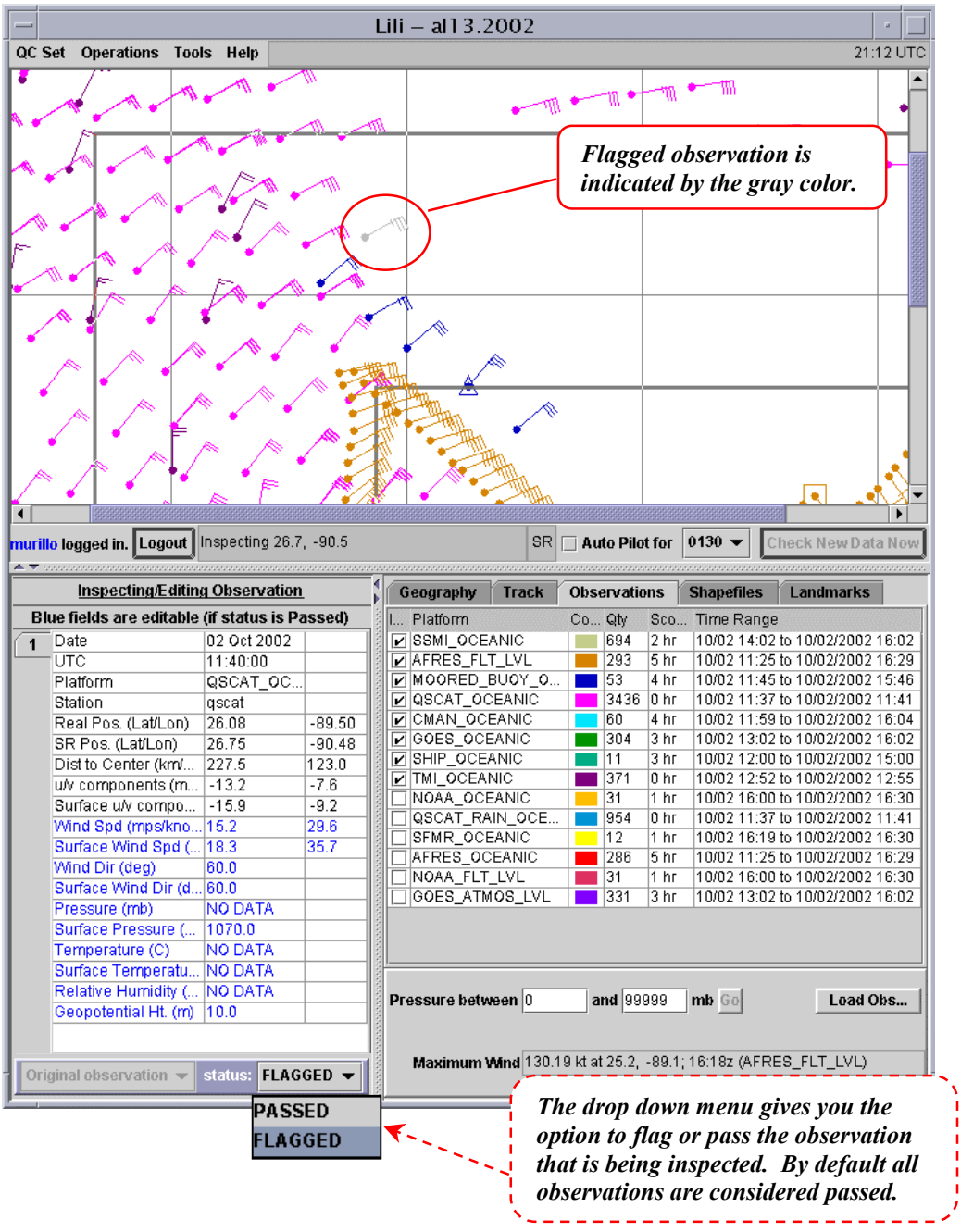
If there are multiple observations with the same latitude and longitude, they will be drawn on top of each other. This may occur when viewing GPSsonde_mutli_lvl (see glossary for information), both flight level and oceanic aircraft data or when examining observations using the earth-relative plot mode. When inspecting the platforms, the inspector panel will display several tabs on the left. Click on the different tabs to view the data. Observations are ordered in ascending order based on pressure.



Tools menu (cont'd)

(Un) Flagging

Observations can be flagged (i.e., omitted) from the analysis in several ways. Choosing the individual flag tool will let you select/flag observations one by one. Observations can also be flagged individually using the inspect/edit tool. Both methods are shown below. (Note: The same rules apply for unflagging.)



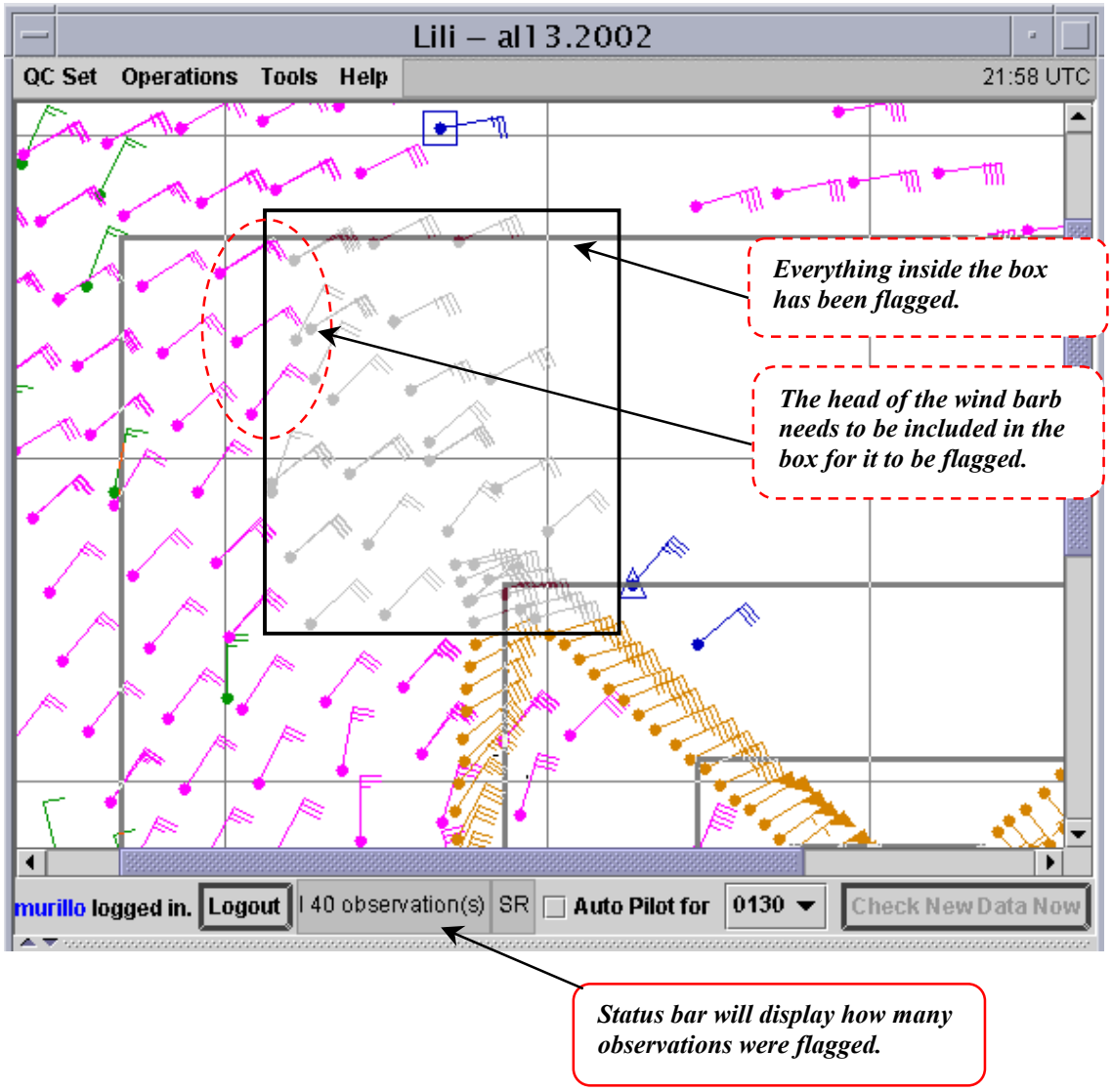
Tools menu (cont'd)

Group (un) flagging

The group-flagging tool provides a way of flagging large numbers of observations in a desired area. Under the group-flagging tool there are two options: **Flag All** or **Flag by Platform**. Choose the area that needs to be flagged by clicking and dragging the mouse to form a box (as shown below).

(1) Flag All
The **Flag All** option will flag all observations in the chosen area. (Note: The same rules apply for *Unflag All*.)

Example of Flag All



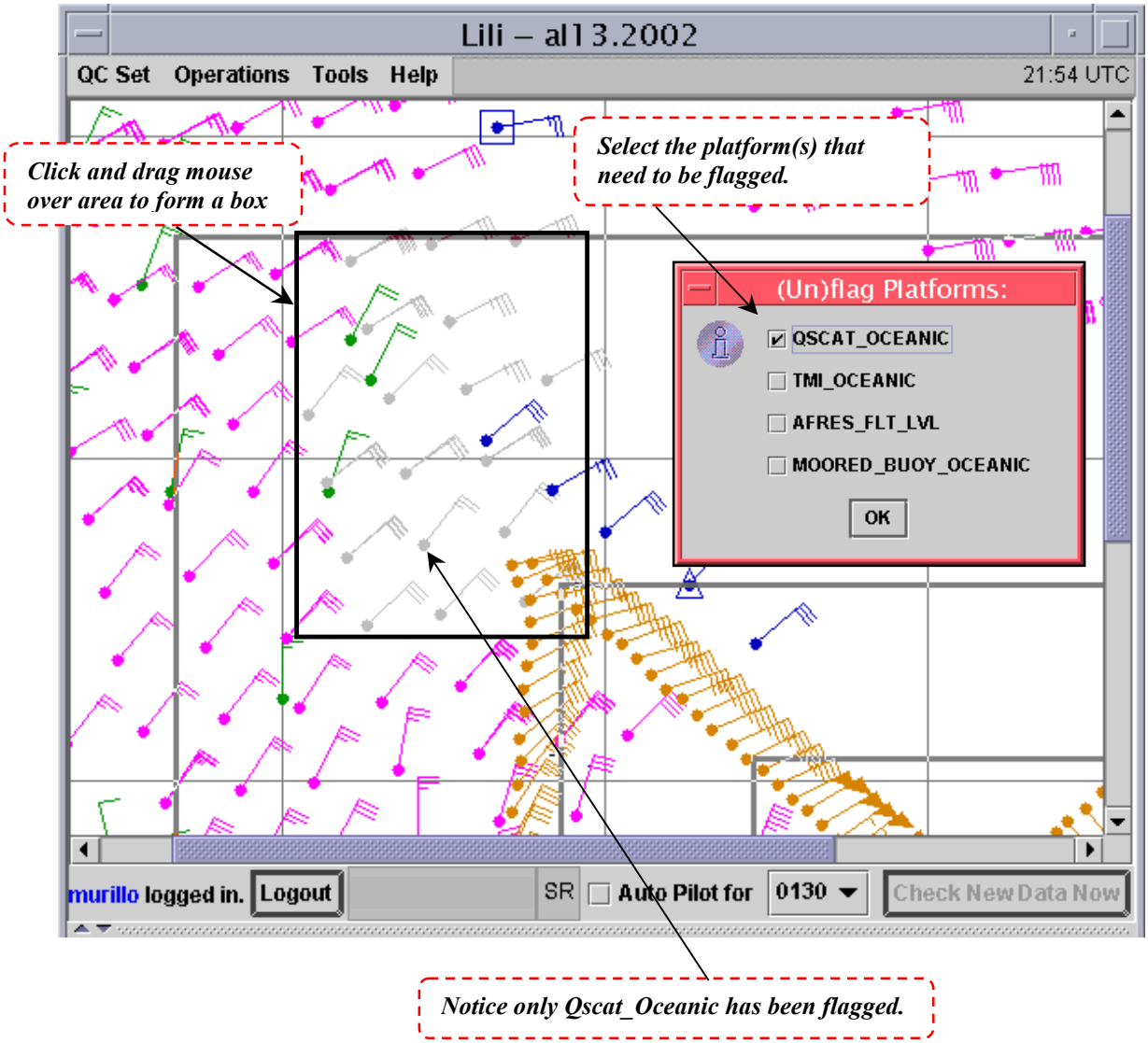
Tools menu (cont'd)

Group (un) flagging (cont'd)

(2) Flag by Platform

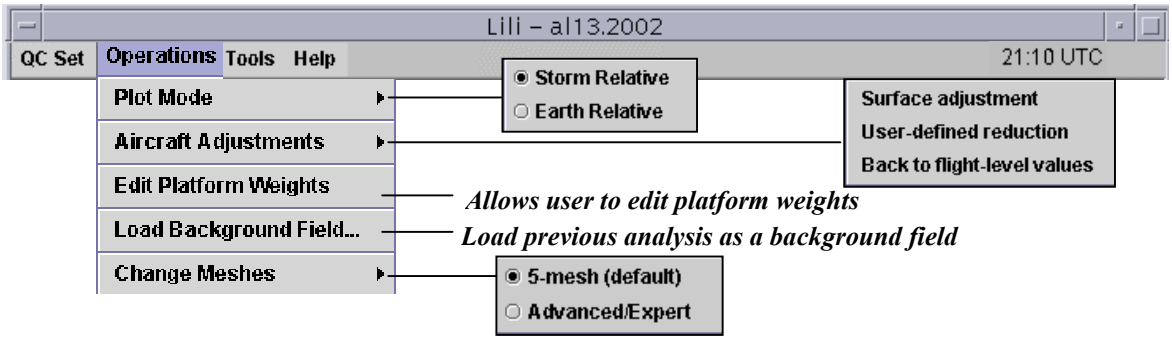
Click and drag the mouse to form a box around the desired area. The **Flag by Platform** option will first give you a list of all platforms in the selected area. The user then has the choice to flag by platform. (Note: The same rules apply for *Unflag by platform*.)

Example of Flag by Platform



Operations Menu

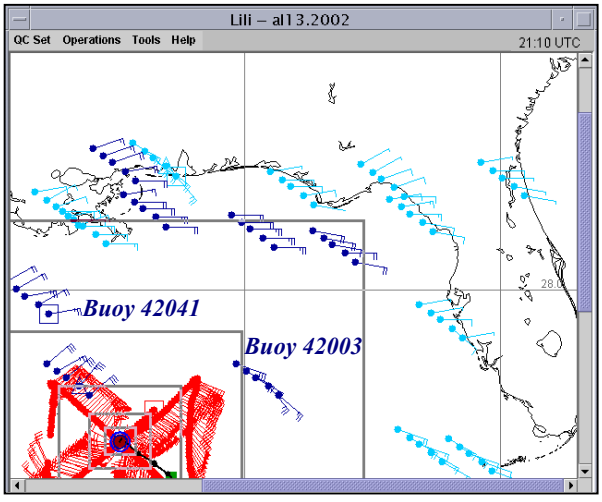
Under operations, users will find plotting options, analysis parameters and methods to surface adjust aircraft data. The operations menu is found up on the menu bar.



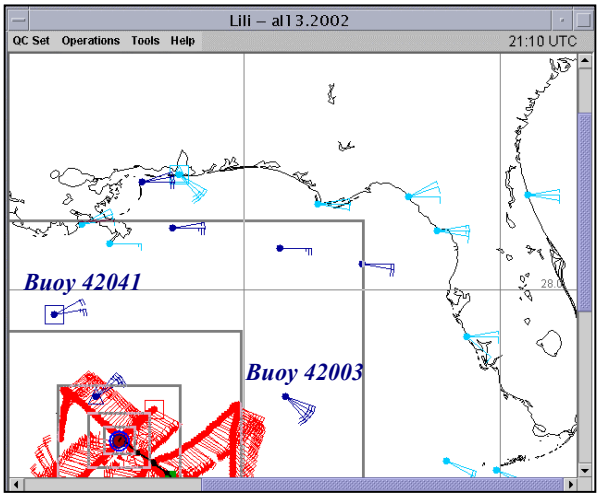
Plot Mode

Plot mode provides two ways to view the observations: **storm-relative** observations are plotted with respect to the moving storm, while **earth-relative** observations are displayed with respect to their true positions on the earth. The examples below show the difference between the two plot modes. Notice the dark blue wind barbs (moored buoy observations) appear differently in the different plot modes.

Storm-Relative



Earth-Relative



Operations Menu (cont'd)

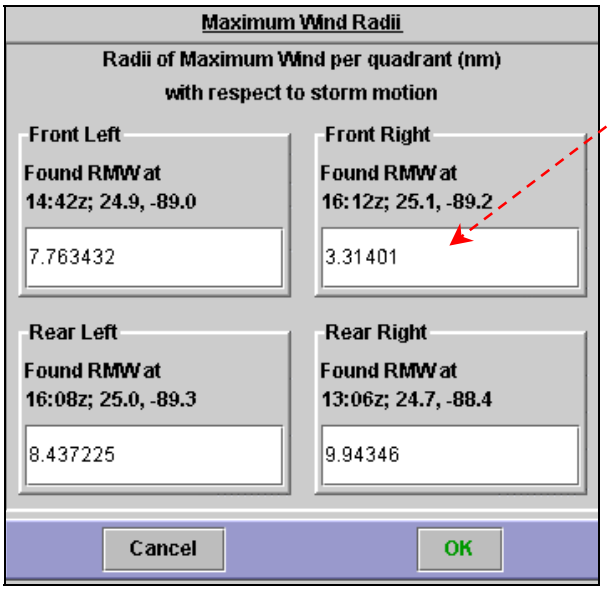
Aircraft Adjustments

There are three methods for adjusting aircraft flight-level winds to the surface (10 meters). The "oceanic" label is assigned to observations adjusted by the HRD PBL model described in Powell (1980) and Powell et al. 1996. Two additional methods are based on recent GPS dropsonde research as follows:

(1) Surface Adjustment

The first method is called **Surface Adjustment**. This method, developed by Dunion and Powell (2002), examines data from GPS dropsondes obtained for a three-year period. They found that aircraft flight-level data from 700 mb was typically slower than the mean boundary layer (MBL) winds currently used in the surface adjustment scheme. Also, the operational HRD adjustment of MBL winds to equivalent surface winds appears to have a slow bias in MBL high wind speed regimes (greater than 100 kts). These modifications were incorporated in the improved surface algorithms. This new algorithm requires the input of radii of maximum wind per quadrant that is based on aircraft flight-level data. Users can modify these values if necessary.

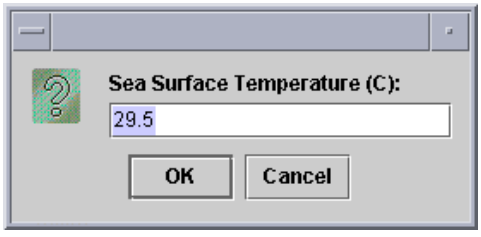
When selecting **Surface Adjustment** the following series of panels will appear. The first window will inform the user of the maximum wind radii in nautical miles (nm) per quadrant with respect to the storm motion. This information coincides with the symbols on the aircraft flight-level data seen on the map. (See page 21 for symbols and what they mean.) The numbers shown are for the Hurricane Lili (2002) dataset shown throughout this manual.



These values can be changed if necessary.

If all values look reasonable, click ok.
The following window below will prompt you for an SST value.

By Default 29.5° C is given.



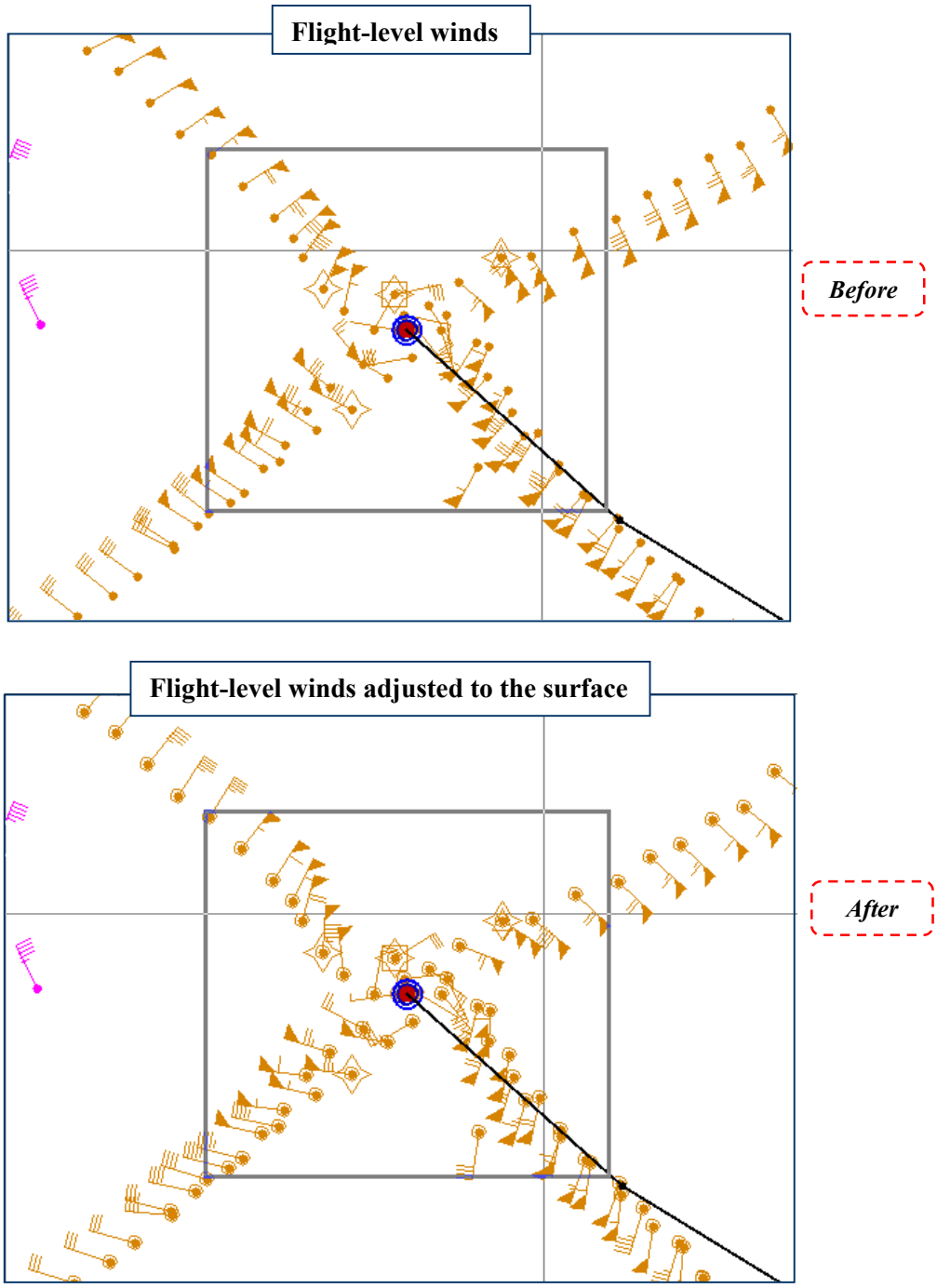
The map will now redraw the aircraft flight-level data to represent winds at the surface. An example of this shown on the next page. To undo this adjustment select **Back to flight-level values**, under the Operations menu.

Operations Menu (cont'd)

Aircraft Adjustments (cont'd)

(1) Surface Adjustment (cont'd)

Below is an example of the flight-level observations before and after the surface adjustment method is performed.

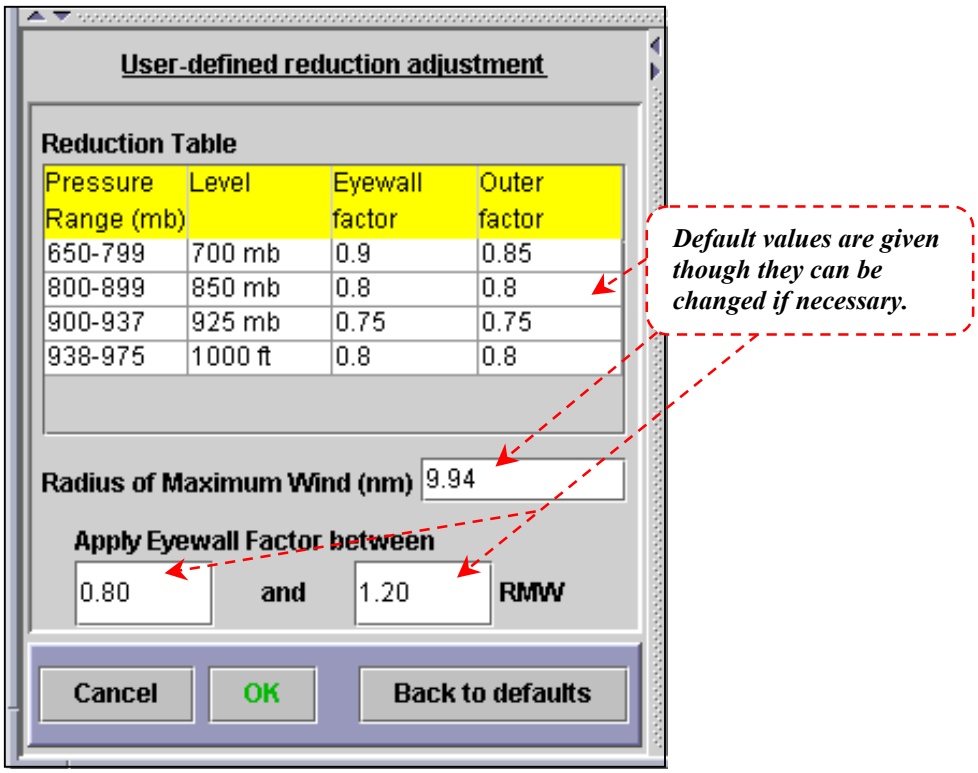


Operations Menu (cont'd)

Aircraft Adjustments (cont'd)

(2) User-defined reduction

This is the second method that can be used to adjust aircraft flight-level winds to the surface. This method was developed by Franklin et al. (2003). In their study, GPS dropsonde data were divided into two categories, eyewall and outer vortex. Mean wind profiles were constructed. The following panel shows the reduction table derived from their study. All adjustment factors shown, including the radius of maximum wind can be changed if needed. To obtain original values, select the **Back to defaults** button.



The map will now redraw the aircraft flight-level data to represent winds at the surface (see next page). To undo this adjustment select **Back to flight-level values** under the Operations Menu.

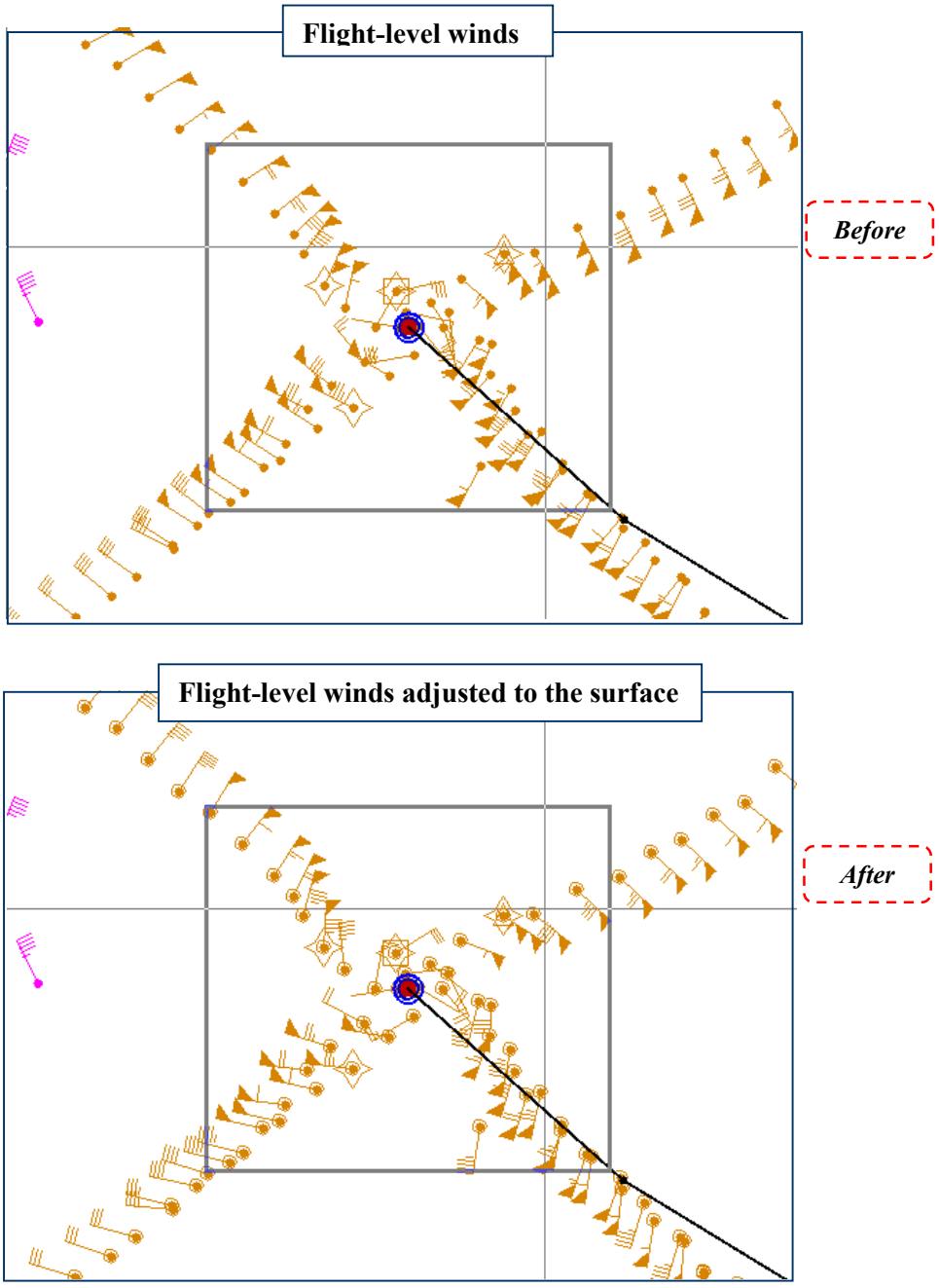
NOTE: Adjustments are always based on flight-level measurements. Therefore, any new adjustment will discard pervious values and calculate new ones from scratch.

Operations Menu (cont'd)

Aircraft Adjustments (cont'd)

(2) User-defined reduction (cont'd)

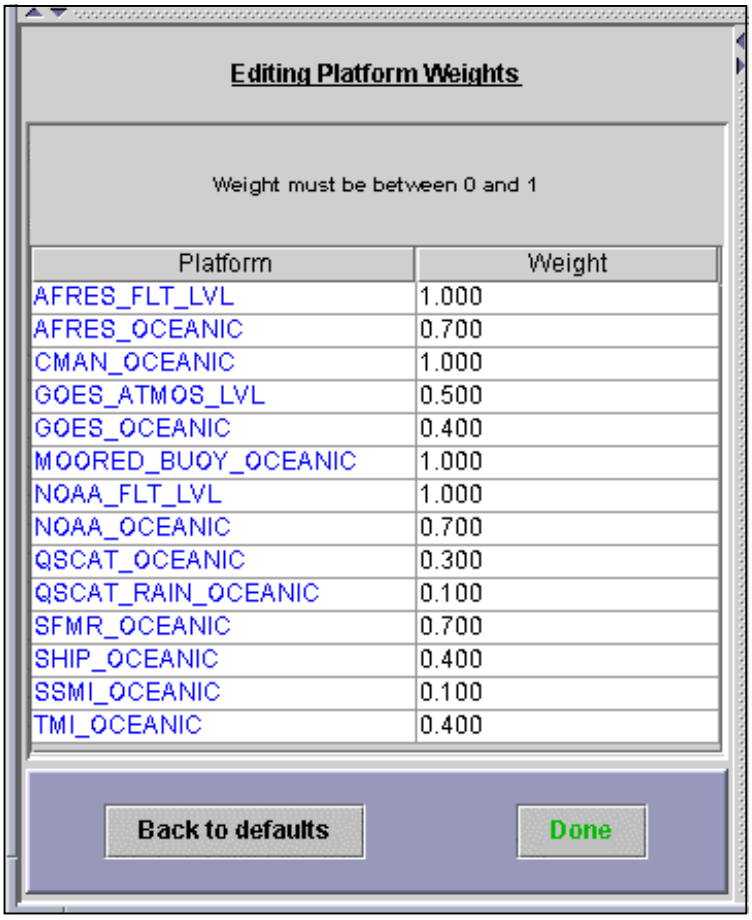
Below is an example of the flight-level observations before and after the user-defined reduction method is performed.



Operations Menu (cont'd)

Edit Platform Weights

All platforms have pre-assigned weights. These weights are based on research studies done by scientists at HRD. This feature allows the user to edit platform weights if necessary. These weights will be used in the analysis process.



Other weights for platforms not shown above are listed below:

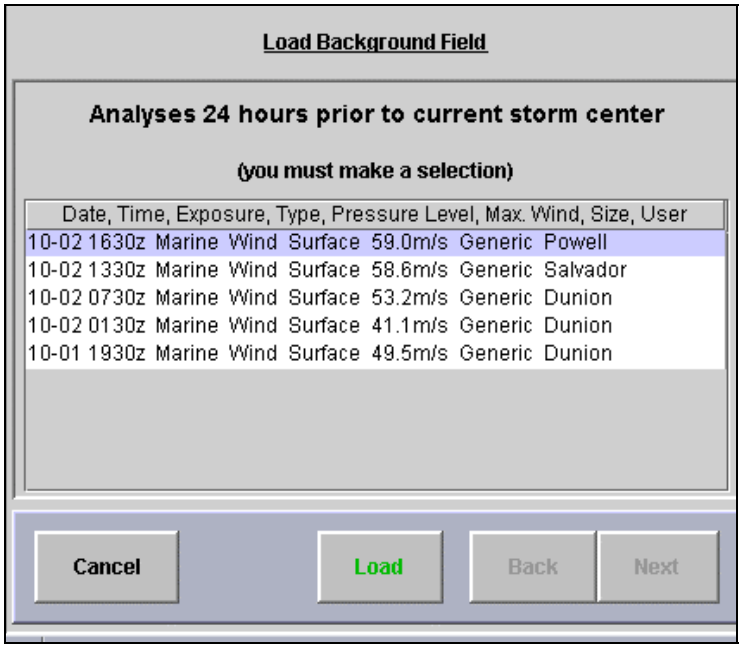
Platform	Weight
GPSSonde_Oceanic	0.700
GPSSonde_SFC_Oceanic	0.800
GPSSonde_Mutli_Lvl	1.000
GPSSonde_WL150_Lvl	1.000
GPSSonde_WL150_Oceanic	0.800
Drifting_Buoy_Oceanic	0.300

Platform	Weight
Metar_Land	0.700
Background_Field	0.050
GMS_Atmos_Lvl	0.500
GMS_Oceanic	0.400
GOES_SWIR_Atmos_Lvl	0.400
GOES_SWIR_Oceanic	0.400

Operations Menu (cont'd)

Load Background Field

This feature allows the user to load the previous analysis as a background field. The background field is a gridded field created during the analysis process. It has a resolution of 24 km x 24 km. A background field is helpful when there are few data present in parts of the current analysis domain. When choosing this option the following panel will appear on the bottom left corner of the window, showing a list of the analyses for the past 24 hours. Some information is given about each analysis.

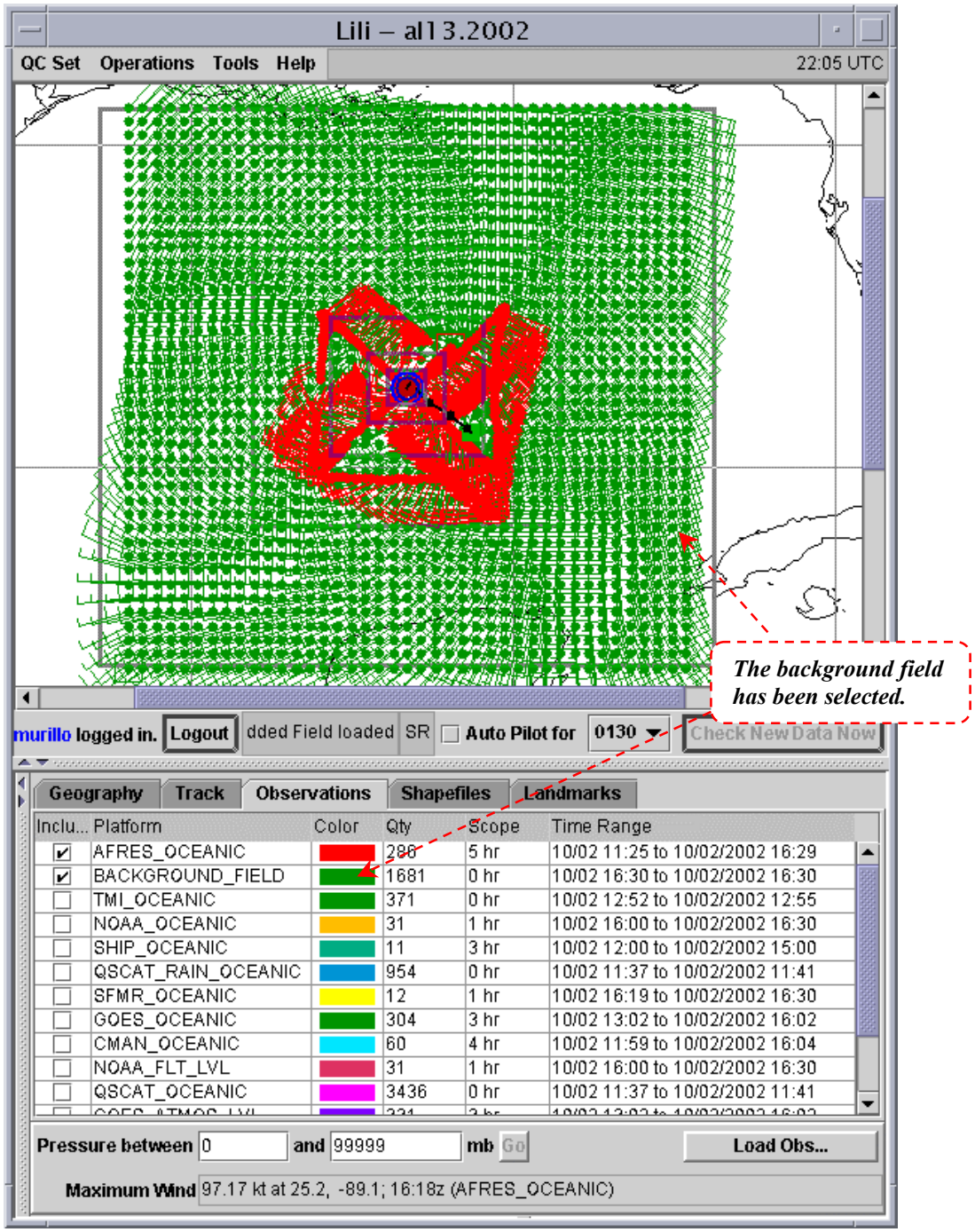


Typically a user should choose the most current (current to the analysis time) background field available. Since the background field has a low weighting (0.050), its impact on the analysis is minimal when other data are present.

Operations Menu (cont'd)

Load Background Field (cont'd)

Once loaded, the background field will appear as a platform on the observations list. Select the background field platform and it will appear on the map. An example is shown below. A background field may also be flagged just like all other platforms.



Operations Menu (cont'd)

Change Meshes

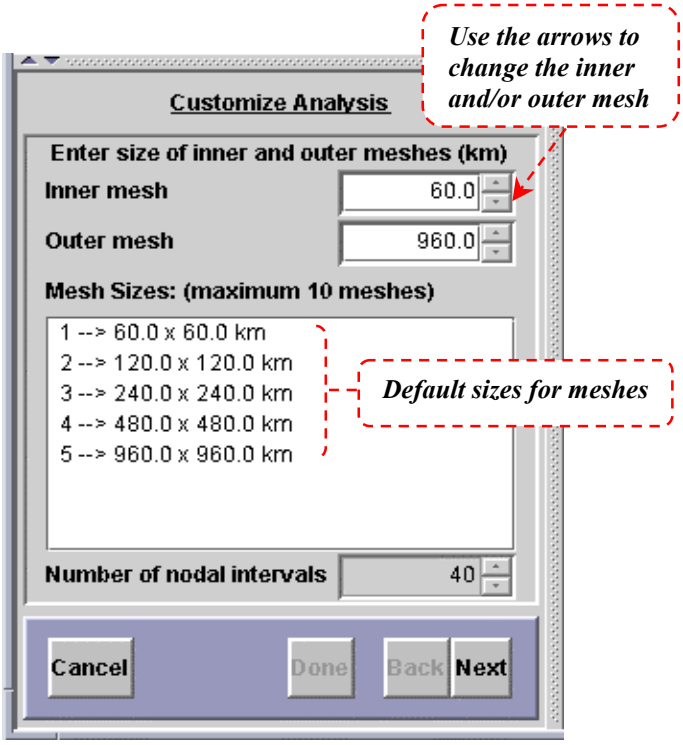
(1) 5-mesh (default)

By default, 5 meshes with pre-defined sizes are used in the analysis process. These meshes are visible once a track is loaded.

(2) Advance/Expert

Disclaimer: Only users who are very familiar with the HRD Spline Analysis and have extensive background knowledge on it should use the Advance/expert mode. Adjusting parameters without any knowledge may result in an erroneous analysis.

Meshes can be changed if needed. When selecting this feature the following series of panels will appear at the bottom left of the H*Wind window.



These are the default values for the 5 mesh sizes. The inner and outer mesh can be changed from this panel using the arrows. Notice that the meshes drawn on the map will change instantly. Changing the inner or outer mesh will either add or remove meshes. All other meshes will double in size from the inner mesh. Increasing (decreasing) the size of the inner mesh will make for a coarser (finer) resolution analysis. Fewer (more) meshes will be involved when the innermost mesh is increased (decreased). The maximum number of meshes per analysis is ten. The outer mesh changes independently from the other meshes. The outer mesh should be the boundary of the data coverage. Making the outer mesh extend far beyond the region of data coverage may result in an erroneous analysis.

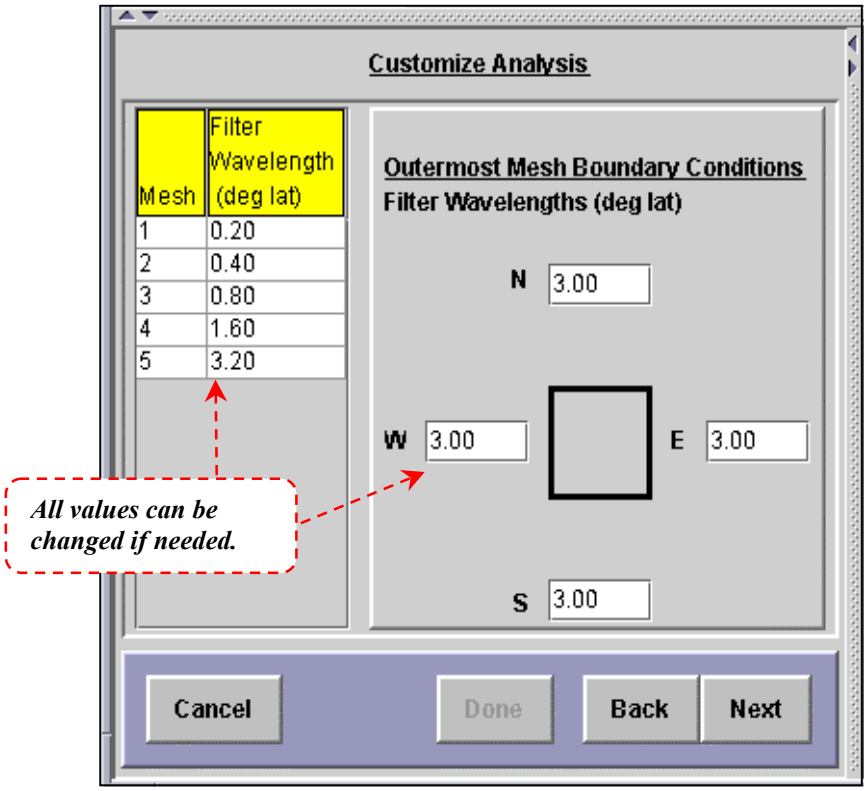
Each nodal interval represents a uniform mesh subdivision in both the x and y directions. While the number of nodal intervals can be controlled by the user for the first mesh, the analysis algorithm automatically adjusts this parameter for the other meshes, based on the domain and a subsequent doubling of the nodal spacing size set for the first mesh. The amount specified should be an even positive integer that is less than or equal to 64.

Operations Menu (cont'd)

Change Meshes (cont'd)

(2) Advance/Expert (cont'd)

The following panel shows detailed information on the filter wavelengths (°lat.) and requested boundaries of each mesh. The values shown are for a five-mesh analysis scheme. If meshes have been added or removed in the previous panel, this panel will reflect those changes as well.



The filter wavelength controls the scale resolution of different features. The selection of a filter wavelength should be based on the desired degree of representation on each mesh. Generally, observational noise and fluctuations on scales smaller than the filter wavelength are suppressed and smoother. However, caution should be used to not set it smaller than the data density so that spurious or erroneous features are not introduced into the analysis.

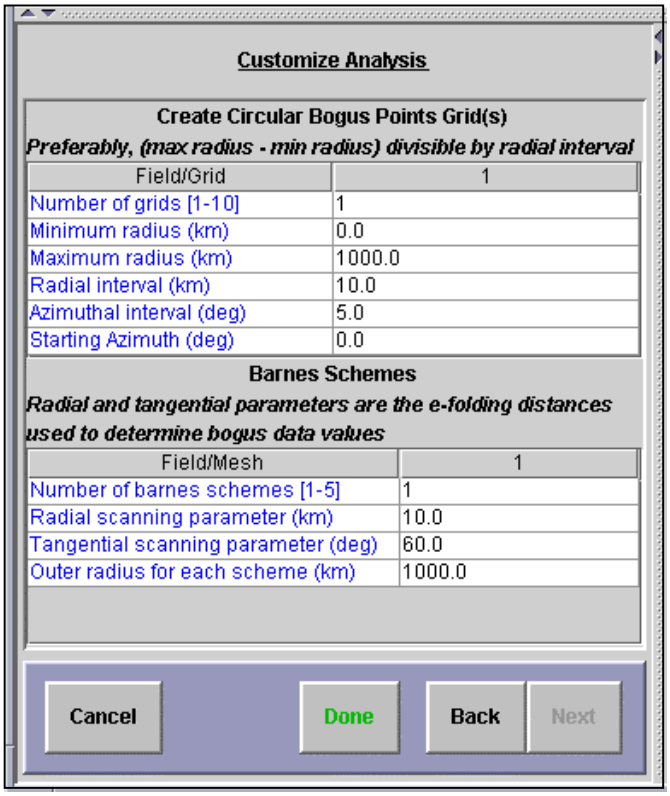
Operations Menu (cont'd)

Change Meshes (cont'd)

(2) Advance/Expert (cont'd)

The following panel shows the information about the bogus observations introduced onto the analysis and the Barnes scanning algorithm parameters used to determine the bogus values. The default values are shown. All fields are editable.

Bogus observations are primarily used to fill in data gaps, especially if they are large relative to the mesh filter, and constrain the radial extent of the vortex. Grids of concentric bogus points rings are generated just prior to the start of the analysis process, and the values are calculated during execution of the analysis software. An example of a bogus observation gridded field is shown on the following page. By default, on grid centered about the storm center position at analysis time is utilized in H*Wind. Depending on the distribution of the data, the user may desire to adjust the size of the grid and/or the density of the bogus points. Multiple grids can also be employed.



A Barnes scanning algorithm computes the bogus values at each point using all real observations that are within five specified e-folding distances in both the radial and tangential directions of a polar coordinate system. The radial and tangential e-folding distance parameters can be adjusted by the user to change the size and extent of the scanning sector. Observations falling within the sector are weighted so that those closest to the bogus point have the greatest influence. The bogus values are then interpolated from the weighted averages of all these observations.

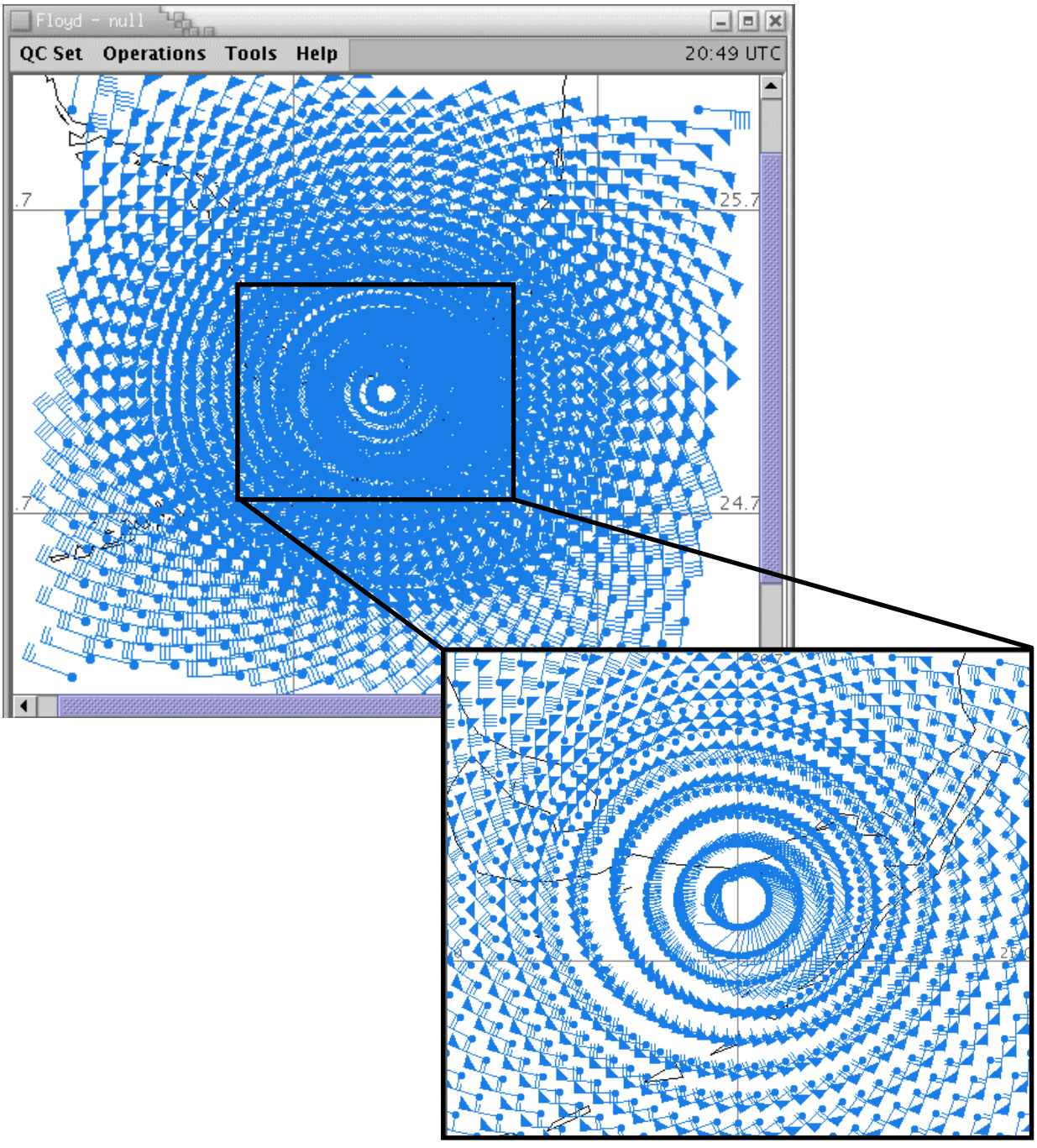
The Barnes algorithm is only recommended to be used in regions where is evidence of a coherent circulation. One set of parameters is utilized by default in H*Wind, and bogus point values will be determined by the scanning algorithm out to a user-adjustable radial limit defined from the storm center position at analysis time. More than one Barnes scheme can be employed; in this case bogus point values will be computed by the algorithm out to the radial boundary of the last scheme. Any bogus observation value beyond this radius will instead be determined by an alternate liner interpolation method.

Operations Menu (cont'd)

Change Meshes (cont'd)

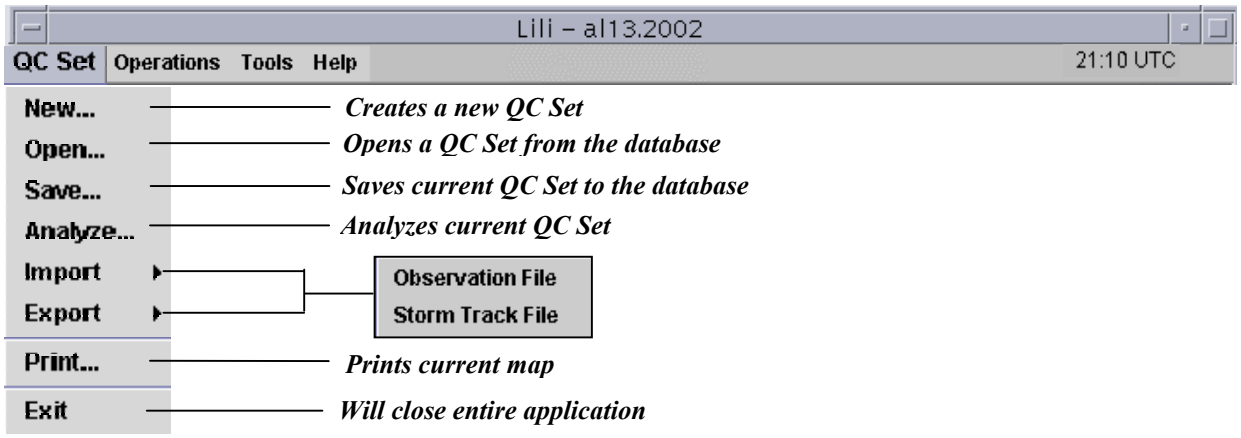
(2) Advance/Expert (cont'd)

Below is an example of what bogus points look like. The current H*Wind version does not have the capability to allow users to view bogus points. The following images have been included in this manual for a better understanding of bogus points.



QC Set Menu

This menu includes features that can be applied to a quality control (QC) Set. A QC Set consists of both a track and observations. The QC Set menu is found up on the menu bar as shown below.

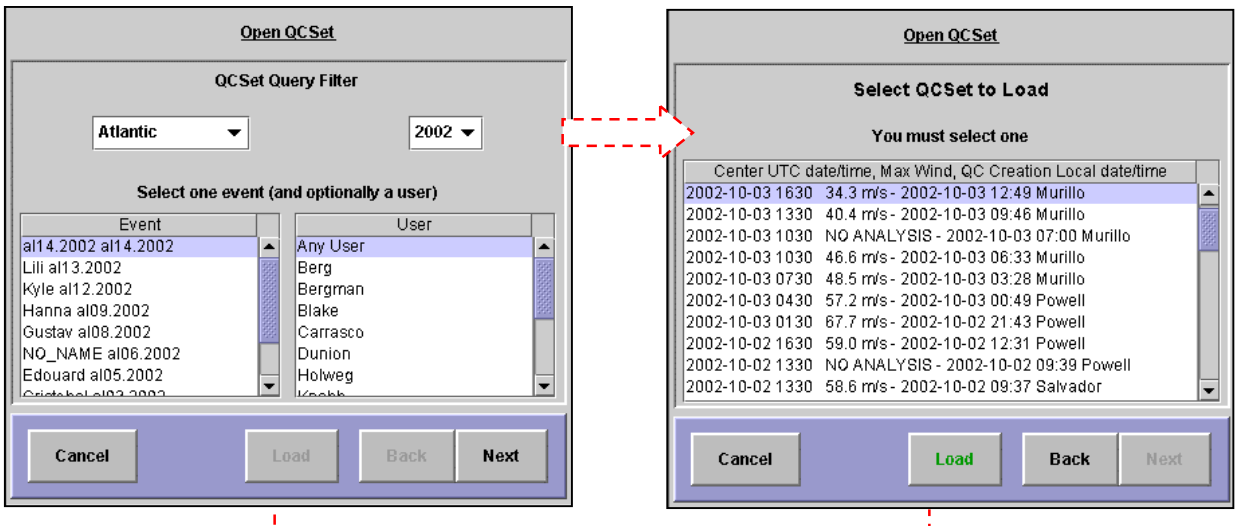


New

This feature will create a new QC Set. If there is a QC Set present, the user will first be prompted to decide if he/she really wants the current data to be removed.

Open

This option will open a QC Set from the database. The following panels will appear.



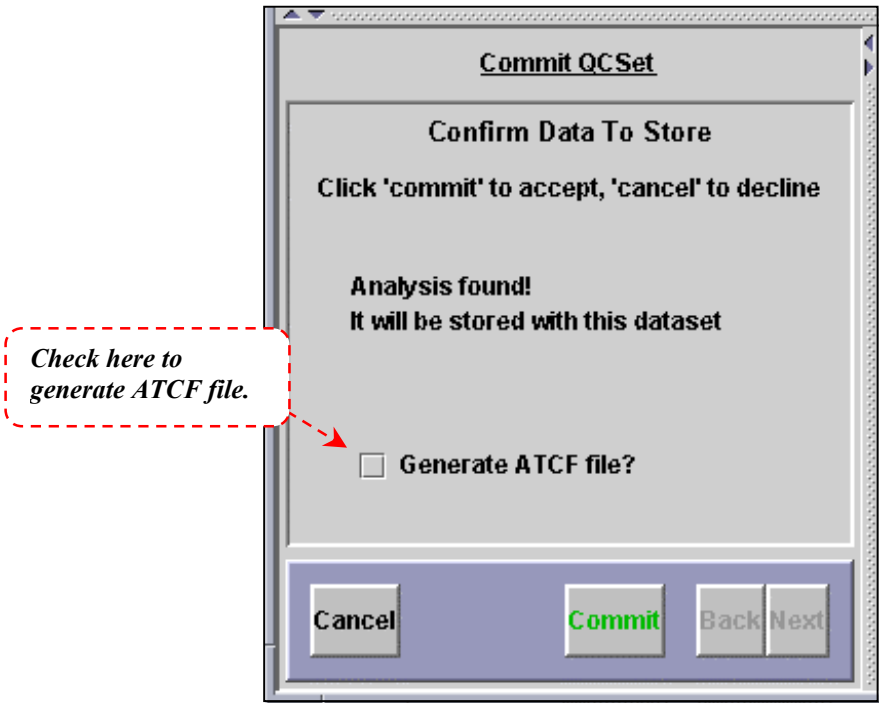
Select the ocean basin and year from the drop down menu, then select the event and user.

Select the desired QC Set and then click Load. Some information is given about each QC Set.

QC Set menu (cont'd)

Save

This feature will save the current QC Set to the database. Typically users will want to save after an analysis has been completed. If an analysis has been done, it will be stored with the QC Set. Users also have the option to generate an ATCF file. This ASCII file follows the ATCF system fix format and will be available at an ftp sever at TPC. The following panel will appear on the lower left portion of the H*Wind window.

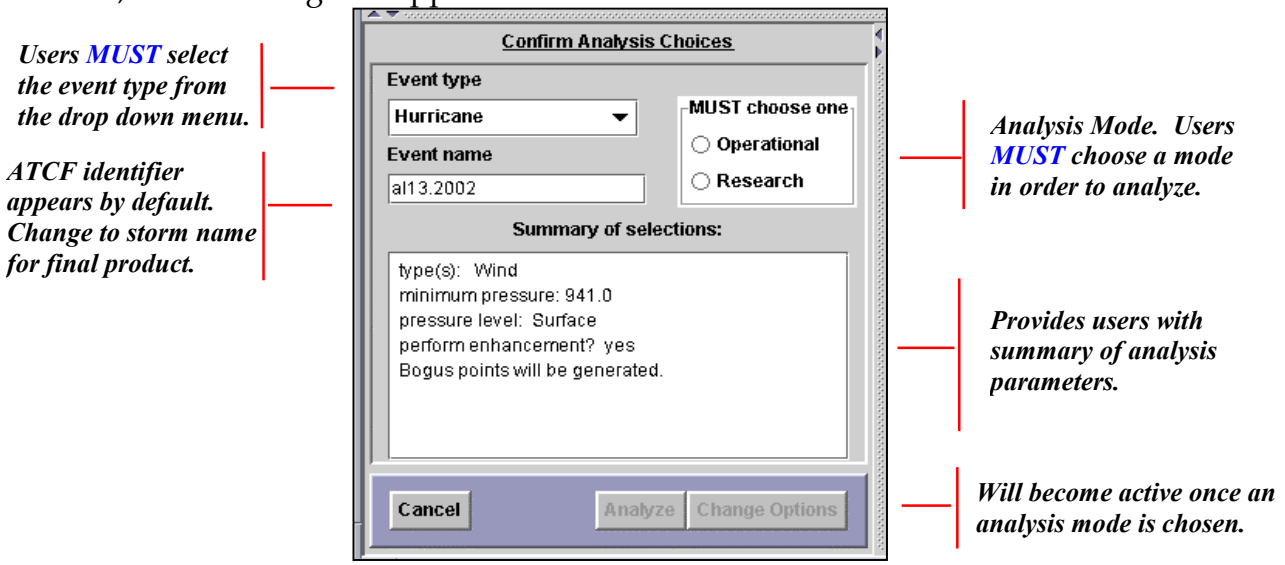


To retrieve saved QC Set select Open under the QC set menu.

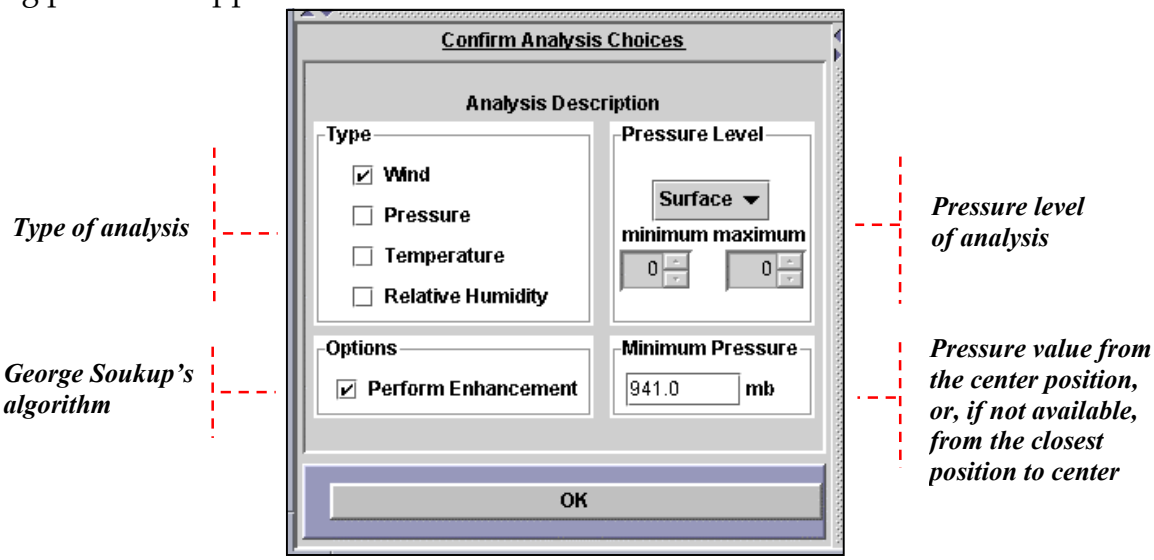
QC Set menu (cont'd)

Analyze

This option will analyze the current QC Set. This feature should be selected only when the user has completed all desired data quality control. During the analysis process, an image, a background field and a gridded ASCII version of the analysis are created. When selecting this feature, the following will appear on the lower left corner of the H*Wind window.



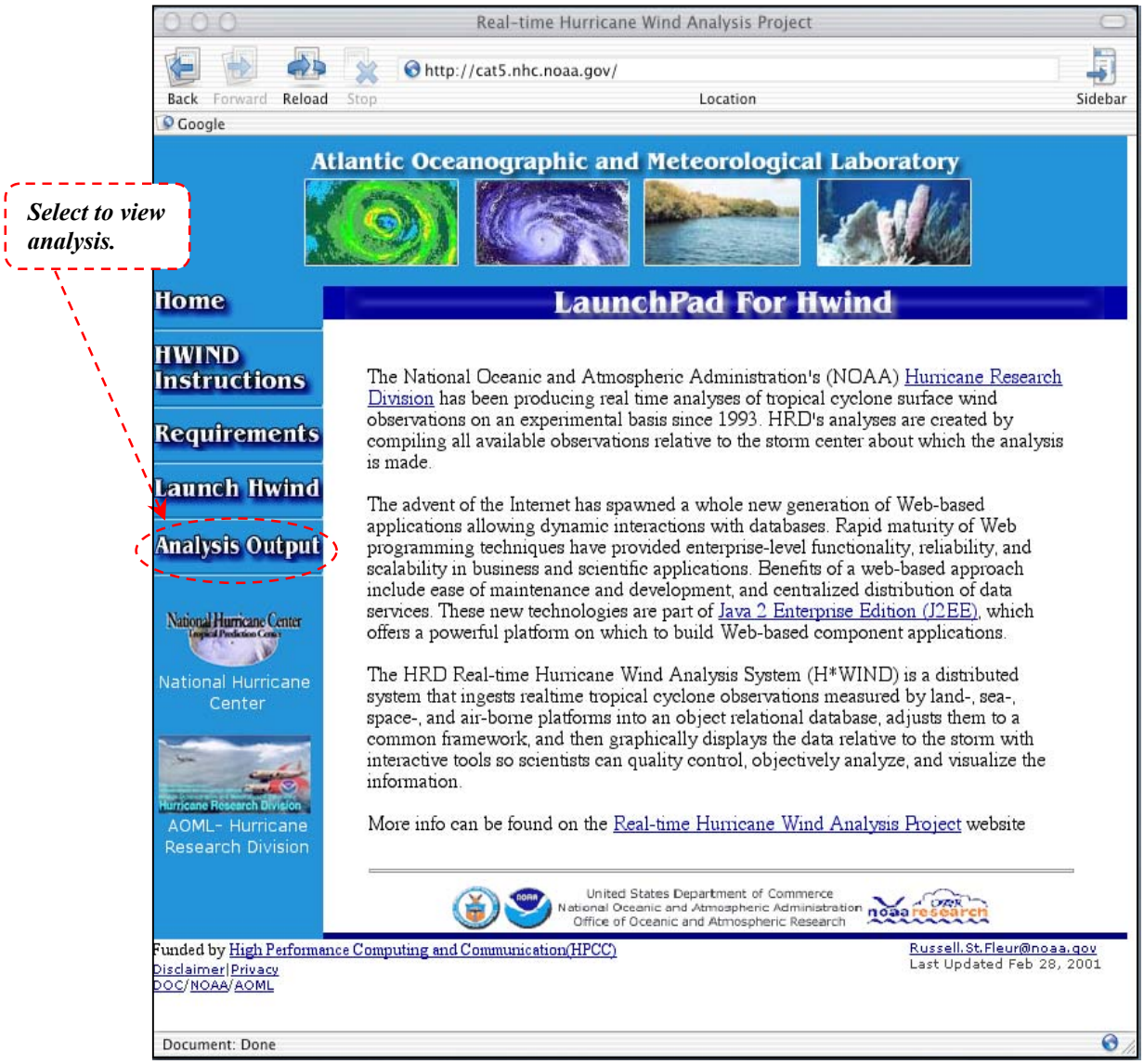
Select the event type and name that will appear on the final image. Users MUST choose an analysis mode AND event type in order to proceed to the next and final step. Once a mode has been chosen, the two buttons on the bottom will be active. Make sure the information under *Summary of selections* is correct. Select **Change Options** to make changes. The following panel will appear.



QC Set menu (cont'd)

Analyze (cont'd)

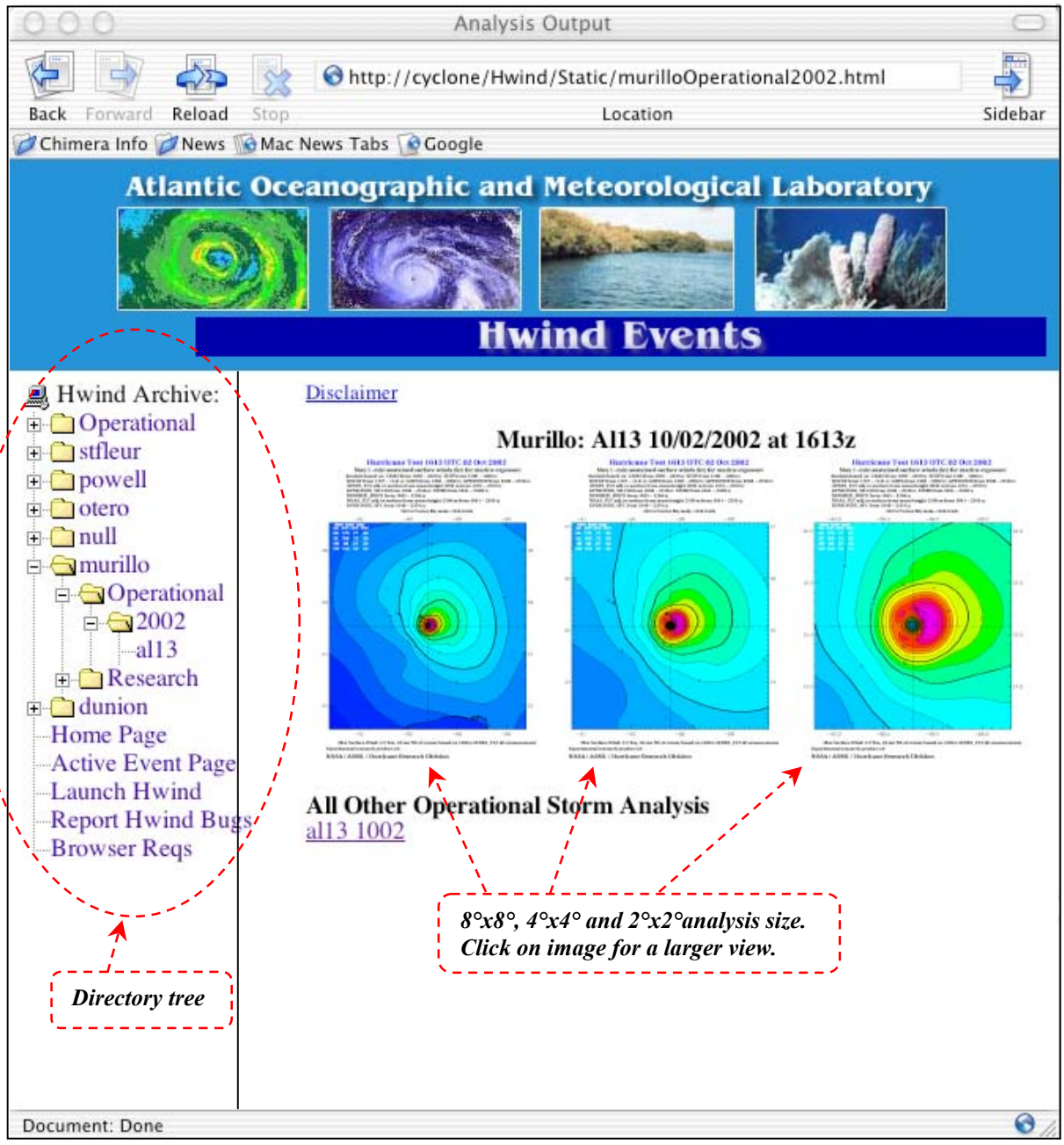
Once the Analyze button is selected a progress bar will appear. When the analysis is completed, a window will pop-up stating where the analysis can be found. Open a web browser to http://cat5.nhc.noaa.gov (shown below) and click on Analysis Output.



QC Set menu (cont'd)

Analyze (cont'd)

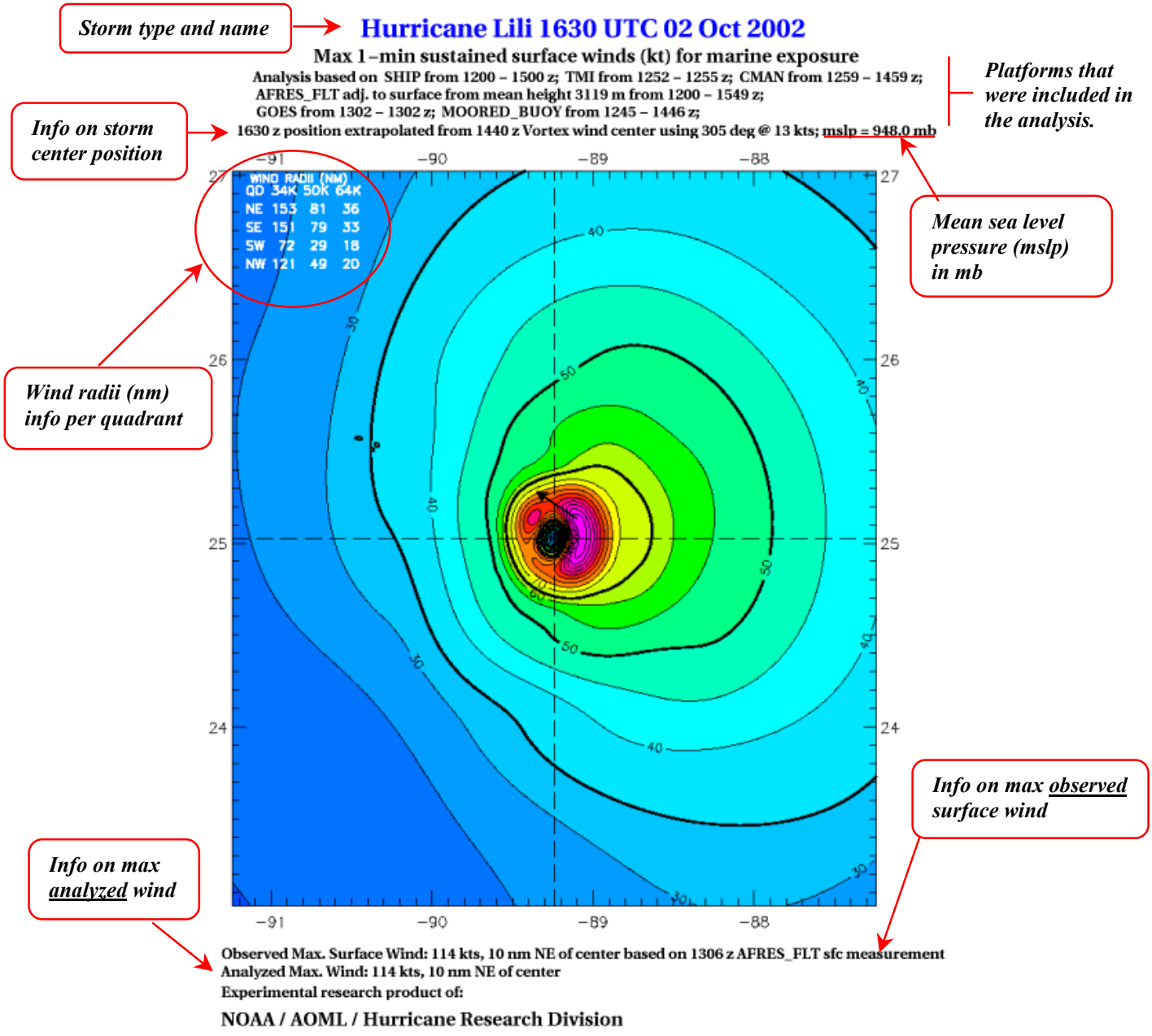
After selecting **Analysis Output**, users will go through a series of windows to find the final analysis. On the left portion of the web page (shown below) there is a directory tree. Click on the user's folder or operational and follow the folders down until you get to the ATCF identifier name. There are three different zoom views of the completed analysis (8°x8°, 4°x4° and 2°x2° box). Click on the desired image for a closer view.



QC Set menu (cont'd)

Analyze (cont'd)

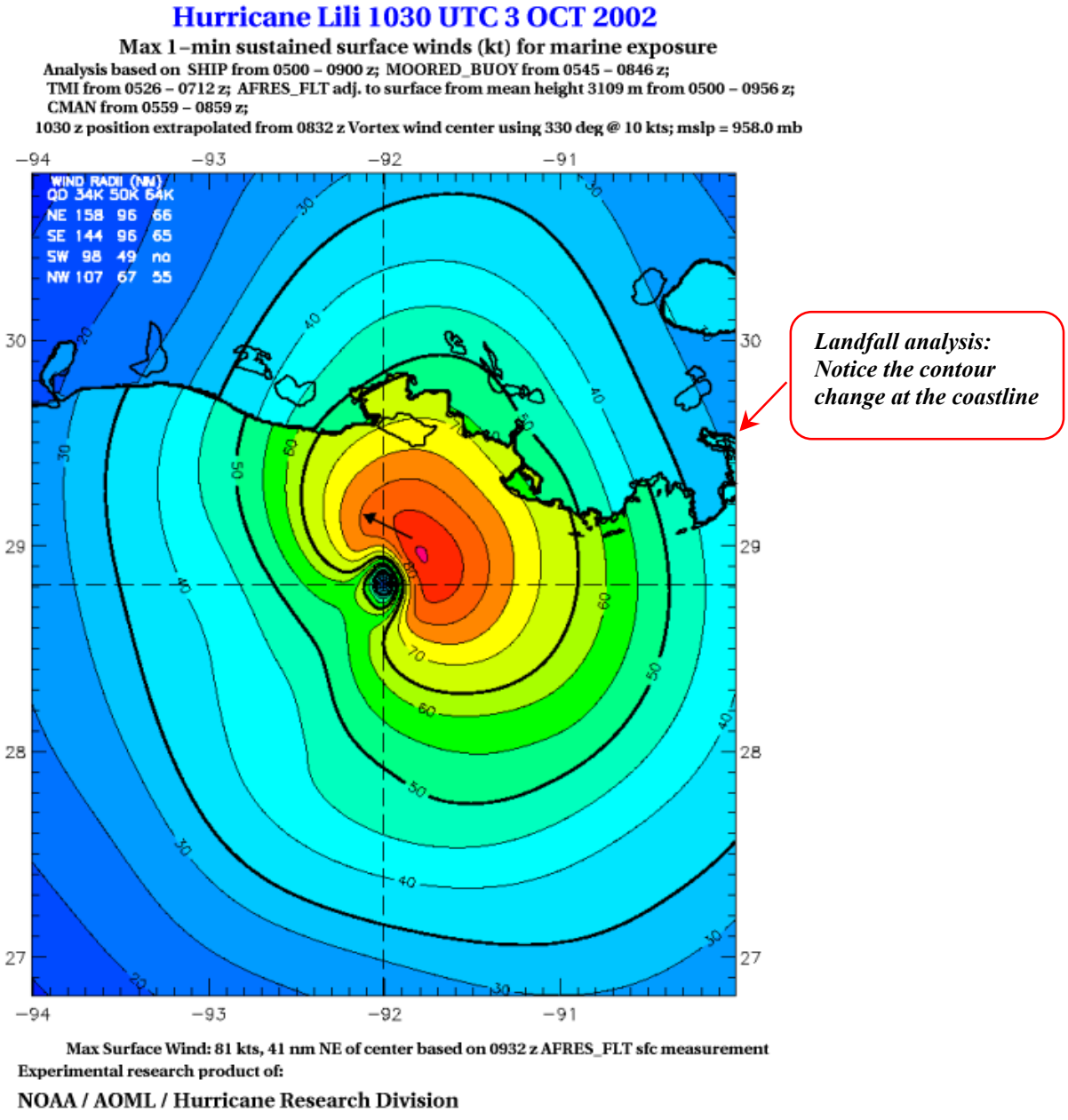
Below is an example of a 4°x4° wind analysis. This analysis corresponds to the various examples used throughout this manual.



QC Set menu (cont'd)

Analyze (cont'd)

The H*Wind analysis scheme takes into account land. The example below shows Hurricane Lili approaching landfall. The isotachs change over land. Land frictional effects were applied to this analysis.

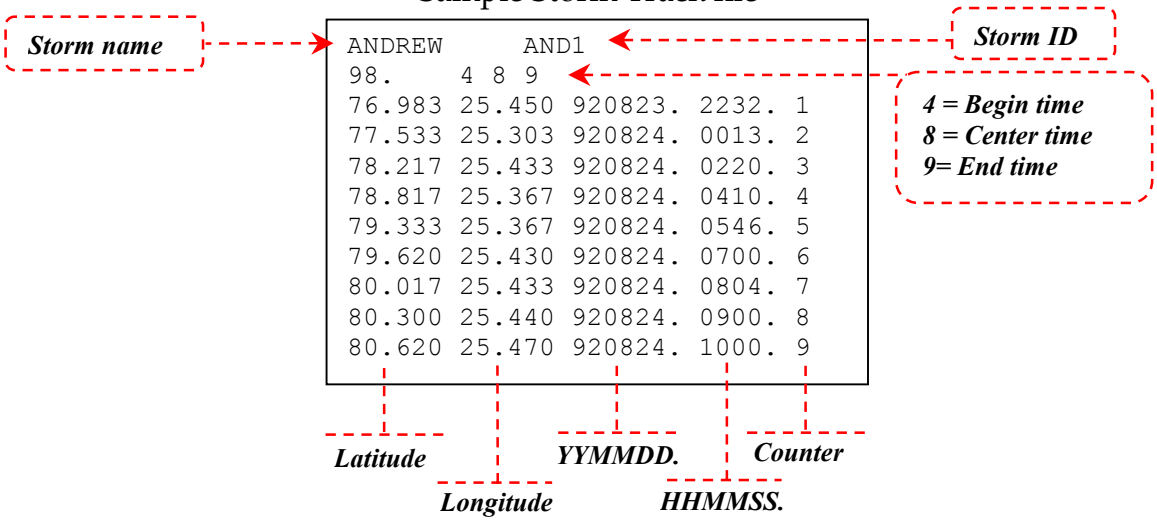


QC Set menu (cont'd)

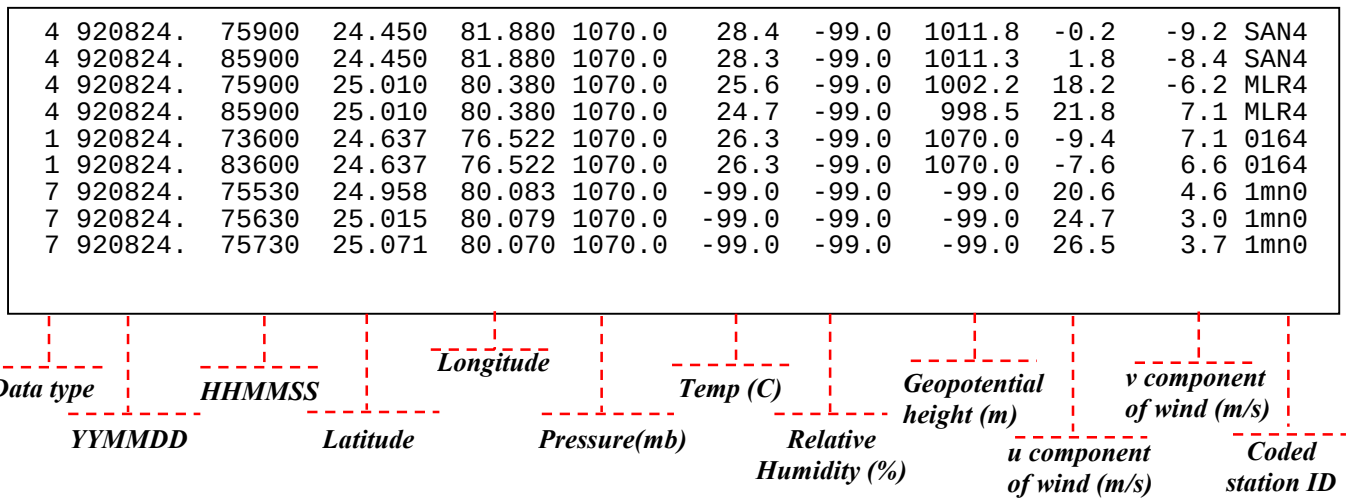
Import

In order to comply with certain legacy file formats, the Import feature allows users to import a storm track and/or an observation file. In general, regular users will depend on the database for their data. These files need to be in a specified format in order to be recognized by H*Wind. Below is an example of a storm track and an observation file.

Sample Storm Track file



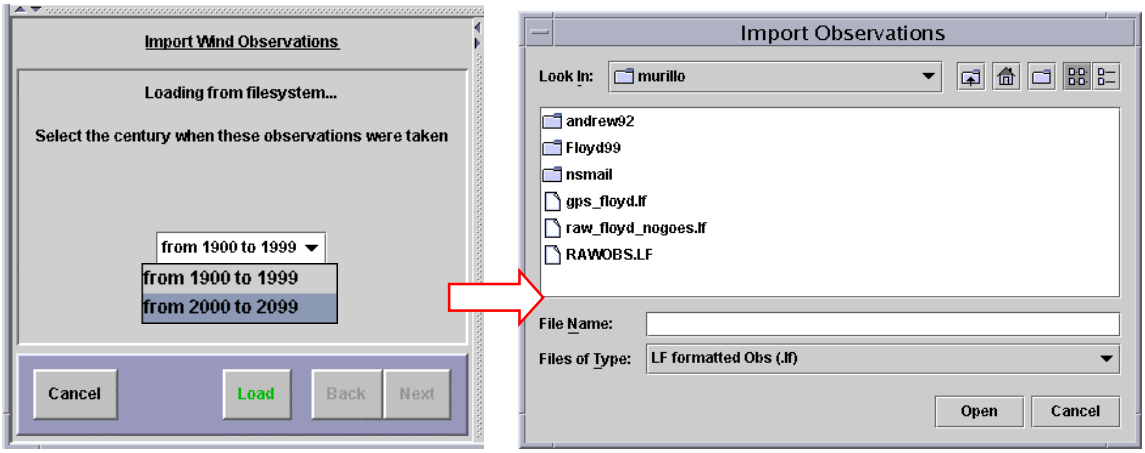
Sample Observation file



QC Set menu (cont'd)

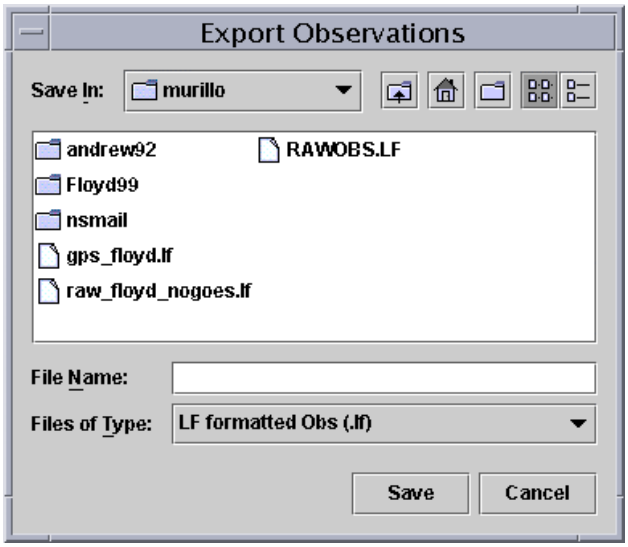
Import (cont'd)

The following are the series of windows that appear when importing files. H*Wind will look for files in your home directory. Since legacy files are not Y2K compliant, users will first need to select the century when the observations were taken. H*Wind will look for files with the *.lf* extension for observations and *.dat* for storm tracks though any file extension can be used.



Export

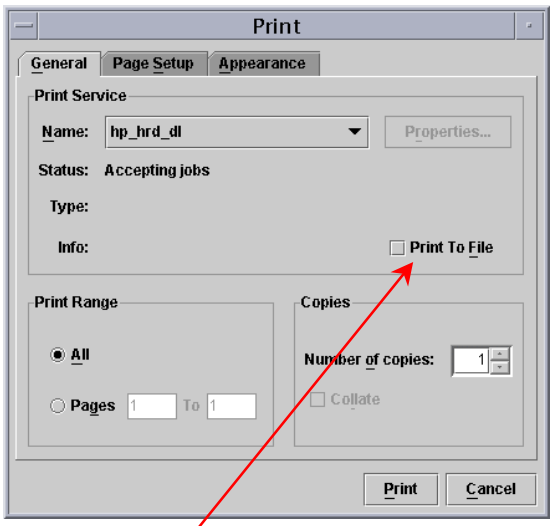
This feature is used to export files. A user can export the storm track and/or observations that are being used in the current H*Wind session. These files will be written in the specified format shown as shown the previous page. When selecting export the following will appear. The file will be written in the users home directory.

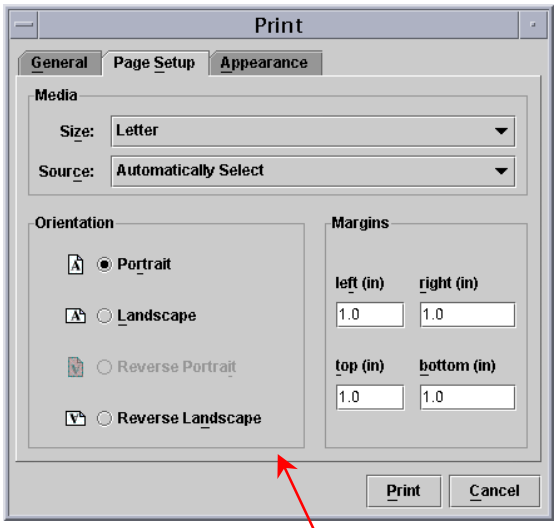


QC Set menu (cont'd)

Print

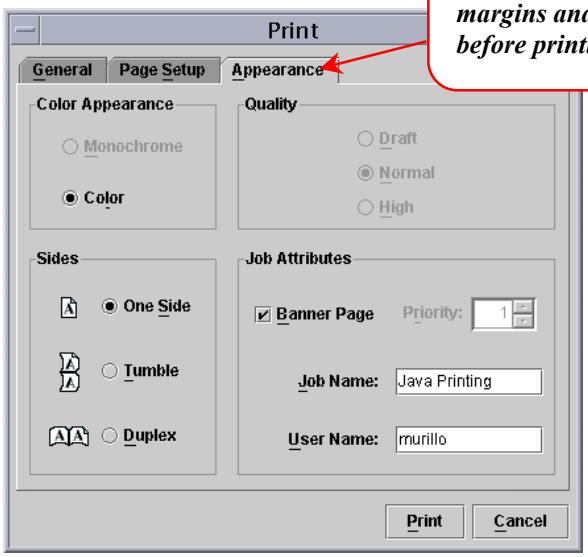
The print option will print the map portion of the frame. The following window will appear. Under the print window there are several tabs that include options for printing.





Users can print to a file. The file will be a PostScript file.

Users can change the paper size, orientation and margins and appearance before printing.



*Glossary of H*Wind terms*

*H*Wind observing platform names are capitalized*

Analysis -A procedure of estimating the continuous spatial field of a physical variable from a set of discrete observational data.

AFRES_FLT_LVL -Air Force reconnaissance flight-level High Density Observation (HDOB).

AFRES_OCEANIC **-**Air Force reconnaissance flight-level High Density Observation (HDOB) data adjusted to the surface (10meter, 1minute) using the PBL model.

Auto Pilot **-**Button located on the status bar is intended for operational use only. This feature will retrieve data and storm track positions every ten minutes up to the selected time. See page 17 for more information.

BACKGROUND_FIELD -Gridded H*Wind wind analysis. Created during analysis process. Sometimes used when little data is present in the data coverage area.

Barnes schemes -Values attributed to bogus points locations.

Bogus points -Circular grid points created during the analysis portion of H*Wind.

Check New Data Now -Button located on the status bar will check for new observations and storm positions from the database every time it is activated. This feature is used during real-time operations. See page 17 for more information.

CMAN_OCEANIC -Hourly observation adjusted to a 10 meter, 1 minute wind based on the Liu model. A roughness length factor is used depending on the wind exposure. A gust factor is applied based on the CMAN's averaging time.
NOTE: Continuous winds are used instead of hourly winds if CMAN reports it.

DRIFTING_BUOY_OCEANIC -Data reported by a drifting buoy estimated at 10 meters.

Earth-relative coordinate system -Observations positioned relative to the earth. See page 31 for more information.

Event -An observed weather phenomenon that originates in the tropics.

Event name -The name of the observed event (e.g., Andrew, Lili or 15).

Event type -The classification of the event (e.g., Tropical Depression, Hurricane or Typhoon).

GMS_ATMOS_LVL -Geostationary Meteorological Satellite -5 (GMS-5) cloud-drift visible (VIS) winds from 600-950 mb.

GMS_OCEANIC -Geostationary Meteorological Satellite -5 (GMS-5) cloud-drift visible (VIS) winds adjusted to the surface using a modified PBL model (See Dunion and Velden 2002 for info).

GOES_ATMOS_LVL -Geostationary Operational Environmental Satellite (GOES) cloud-drift visible (VIS) winds from 600-950 mb.

GOES_OCEANIC - Geostationary Operational Environmental Satellite (GOES) cloud drift visible (VIS) winds adjusted to the surface (10 meter, 1 minute) using a modified version of the PBL model (See Dunion and Velden 2002 for info).

GOES_SWIR_ATMOS_LVL - Geostationary Operational Environmental Satellite (GOES) Short-Wave Infrared (SWIR) cloud-drift winds from 600-950 mb.

GOES_SWIR_OCEANIC - Geostationary Operational Environmental Satellite (GOES) Short-Wave Infrared (SWIR) cloud-drift winds adjusted to the surface using a modified PBL model (See Dunion and Velden 2002 for info).

GPSSONDE_MBL_LVL -GPSsonde mean boundary layer (MBL) wind reported in the TEMP drop message.

GPSSONDE_MBL_OCEANIC -GPSsonde mean boundary layer (MBL) wind reported in the TEMP drop message adjusted to the surface (10 meter, 1 minute) based on the HRD PBL model.

GPSSONDE_MULTI_LVL -GPSsonde significant and mandatory levels reported in the TEMP drop message.

GPSSONDE_SFC_OCEANIC -GPSsonde surface wind value reported in the TEMP drop message.

GPSSONDE_WL150_LVL -Wind average over the lowest available 150 m of the sounding based on the GPS sonde measurement reported in the TEMP drop message.

GPSSONDE_WL150_OCEANIC -Wind average over the lowest available 150 m of the sounding is adjusted to the surface based on Franklin's method.

INLAND Data -INLAND refers to an open terrain exposure. Data termed INLAND has been adjusted to a 10 meter, 1 minute wind using the Log law assuming neutral conditions. Inland data consists of metar with known and unknown roughness lengths.

Landmark file -ASCII files that contain information on various geographical landmarks. See page 23 for more information.

Menu bar -A horizontal bar found on the top of the H*Wind window. Several drop down menus are found on this bar. See page 8 for example.

METAR_LAND -Hourly observation adjusted to a 10 meter, 1 minute open terrain wind using the Log model. A gust factor is applied. A roughness length parameter is also included depending on the type of exposure if available.

METAR_LD_TO_OCEANIC -Hourly observation adjusted to a 10 meter, 1 minute wind value based on the Log model. A gust factor is applied as well as a roughness length parameter based on the wind exposure. It is then converted to an equivalent observation with marine (oceanic) exposure.

MOORED_BUOY_OCEANIC -Hourly observation adjusted to a 10 meter, 1 minute wind based on the Liu model. A gust factor is applied based on the buoy's averaging time. *NOTE:* Continuous winds are used instead of hourly winds if buoy reports it.

NOAA_FLT_LVL -NOAA aircraft flight-level minute observations (minob).

NOAA_OCEANIC -NOAA aircraft flight-level minute observation (minob) data adjusted to the surface (10 meter, 1 minute) wind using the HRD PBL model.

OCEANIC data -OCEANIC is an exposure type. Data termed OCEANIC has been adjusted to 10 meters, 1 minute wind using the Liu model.

QSCAT_OCEANIC -QuikScat surface winds adjusted to a 1 minute wind by estimating a time scale for the QScat measurement as the ratio footprint of 25 km/wind speed and then using a gust factor to estimate the max 1 min wind speed.

QCSAT_RAIN_OCEANIC -QuikScat surface rain-flagged winds adjusted to a 1 minute wind by estimating a time scale for the QScat measurement as the ratio footprint of 25 km/wind speed and then using a gust factor to estimate the max 1 min wind speed.

QC Set -A Quality Control (QC) Set contains both a storm track and observations. See page 43 for detailed information.

SFMR_OCEANIC -Stepped frequency microwave radiometer [(SFMR) onboard NOAA aircrafts] surface winds adjusted to a 1 minute wind. Since the SFMR cannot detect wind directions, they are calculated using the flight level wind directions and applying an inflow of 20°. A bias correction is also applied to the wind speed based on Uhlhorn and Black 2003.

Shapefile -A binary file that stores nontopological geometry and attribute information for spatial features in a dataset. See page 22 for more information.

SHIP_OCEANIC -Hourly observation adjusted to a 10 meter, 1 minute wind based on the Liu model.

SSMI_OCEANIC -Special sensor microwave/imager (SSM/I) surface wind speed adjusted to a 10 meter, 1 minute wind by estimating a time scale for the (SSM/I) measurement footprint of 40 km and then using a gust factor to estimate the max 1 min wind speed. NOTE: Bogus cyclonic wind directions are applied to these observations.

Status bar -A horizontal bar found in the middle of the H*Wind window. The status bar has information on the user, auto pilot and plot mode. See page 8 for example.

Storm-relative coordinate system -Observations are plotted with respect to the moving storm. See page 31 for more information.

TMI_OCEANIC -Tropical Rainfall Measuring Mission (TRMM) Microwave Imager (TMI) surface wind speeds adjusted to a 10 meter, 1 minute wind the surface using a footprint of 8 km/wind speed and then using a gust factor to estimate the max 1 min wind speed. NOTE: Bogus cyclonic wind directions are applied to these observations

Update map -Button found on the track panel that will retrieve observations based on the begin and end storm positions if the user has made changes to the current track. See page 9 for more information.

Window Shades -Arrow like features located in the frames of panels on the H*wind window. They are used to adjust the size of the panels.

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